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Analysis of the Content of Advanced Avionics Maintenance Jobs

Polly Carpenter-Huffman, John Neufer, Bernard Rostker

A Project AIR FORCE report
prepared for the
United States Air Force

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An analysis of the skills and knowledge required to maintain advanced avionics systems on the flight line to provide a basis for evaluating existing training methods and career structure. Since this information was not available from Air Force sources, the authors devised a unique data-gathering procedure. By debriefing maintenance teams as they came off the job, the authors were able to describe in detail the flow of specific job steps. Analysis of this data revealed the importance for job performance of knowledge of the way components of specific avionics systems are tied together (system integration) and the unimportance of knowledge of electronic principles. Thus, training should stress system integration and be specific to particular models of aircraft These conclusions provided the basis for evaluation and redesign of training. (R-1894-AF and R-2049-AF). (Author)

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PREFACE

This work was undertaken in response to a request from the Tactical Air Command for help in resolving support problems with the Mark II avionics system in the F-111D aircraft. Rand initiated research in two areas: The Project AIR FORCE (formerly Project RAND) Logistics Program undertook studies on avionics hardware/software reliability. The Project AIR FORCE Manpower, Personnel and Training Program undertook a broad inquiry into personnel and training support for advanced avionics. The present report is the result of the latter effort and was done under the project titled "Personnel and Training Support for Advanced Avionics Systems."

Although TAC's original request referred to the Mark II avionics system in the F-111D, the basic problems are observable in all models of the F-111 and in the F-15. It is very likely that, unless policies are changed, similar problems will be observed in the future in the F-16.

This report is one in a series; the other reports are:

R-1894-AF, The Relevance of Training for the Maintenance of Advanced Avionics, Polly Carpenter-Huffman and Bernard Rostker.

R-2049-AF, A Proposed Course for Avionics Technicians, Richard E. Duren.

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SUMMARY

When Rand began to investigate problems of personnel support for the technically advanced avionics in the F-111D, it soon became apparent that similar problems plagued all advanced avionics systems, including those just coming into the inventory. Many of these problems suggested that there was a mismatch between the performance of maintenance and the way training and personnel procedures were designed to support maintenance tasks.

Detailed knowledge of the performance of flight-line maintenance of advanced avionics was not available at the inception of the study. To fill this need, the authors conducted the job content analysis described in this report. The analysis determined that the general skills and knowledge needed for flight-line maintenance of advanced avionics have the following characteristics:

- Much of the job is simple and repetitive, particularly in the Instrument/Autopilot and Communications/ Electronic Countermeasures shops.
- The most demanding part of the job is finding defective components of the avionics system (fault isolation) in the Bombing/Navigation shop.
- Fault isolation is often performed by recognition of patterns of clues. The key to this method of fault

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isolation is familiarity with the patterns of failure of the avionics system.

- o Fault isolation often requires generation of sequences of a variety of system displays (many of which are ambiguous) and interpretation of their meaning. The key to this method of fault isolation is knowledge of how the components of the avionics system are tied together (system integration) and how the displays are generated.
- o Electronic principles are almost never used for fault isolation.
- o Direct use of the technical orders is infrequent.

Our analysis provided principles for design of a formal training program for flight-line maintenance of advanced avionics systems, particularly for the Bombing/Navigation shop. These principles are:

- o The essential features of even the simpler tasks should be taught formally because they are not part of the average person's repertoire.
- o Fault isolation should be taught formally so that the student can become familiar with a wide variety of failure modes and fault isolation techniques.
- o To insure that the gamut of failure modes is taught, the student should learn fault isolation on a trainer

or simulator in which all systems interact that interact on the aircraft.

- Training must be specific to particular models of aircraft because (1) different models of aircraft fail in different ways, and knowledge of patterns of failure is a primary fault isolation technique, and (2) avionics systems on different models of aircraft are integrated differently, and knowledge of the way the system is integrated is crucial for complex fault isolation.

These principles provided the basis for redesign of the training program for flight-line maintenance of advanced avionics bombing/navigation systems. This revised approach is described in A Proposed Course for Avionics Technicians, by Richard E. Duren, The Rand Corporation, R-2049-AF.

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I. INTRODUCTION

This project was initiated when The Rand Corporation received a request from the Tactical Air Command for a disinterested agency study of problems in supporting the Mark II avionics system in the F-111D aircraft. As part of the effort, the authors undertook an in-depth survey of the job content of the flight-line maintenance occupations--Air Force Specialty Codes 326X2A, 326X2B, and 326X2C. The survey was designed to provide a detailed account of flight-line maintenance procedures to be used as a basis for evaluating current training methods and career structures. The procedures developed and the results of the survey are described in this report.

Maintenance of advanced avionics systems is designed to be carried out at the organizational, intermediate, and depot levels. Avionics systems are composed of individual Line Replaceable Units (LRUs); malfunctioning LRUs are identified through the use of on-board, integrated test equipment using minimal external flight-line Aerospace Ground Equipment (AGE). Removed LRUs are analyzed in the intermediate maintenance shop on test stations that check internal circuitry against predetermined tolerances. Intermediate maintenance actions extend to the removal and replacement of LRU subcomponents, Shop Replaceable Units (SRUs), whose repair is usually the responsibility of the depot.

THE NEED FOR A JOB CONTENT ANALYSIS

After several visits to F-111 units at Cannon, Mountain Home, and Nellis Air Force Bases, and a visit to the Lowry Technical Training Center, it became apparent that there was not a consistent view of the job content of avionics flight-line maintenance activities. The Rand study team considered a job content description critical in any evaluation of F-111 training.

To obtain a job content description of the F-111 maintenance activities required a unique data collection effort. A review of the maintenance data system showed that the existing Action Taken Code structure fails to provide a detailed account of job content. The codes are so aggregated that they do not describe what the job consisted of--e.g., all troubleshooting is assigned one code. In addition, codes are not applied consistently; the same action may be coded "remove-install" at one time and as "troubleshoot and remove-install" at another.

Occupational Surveys were not available for avionics flight-line maintenance (the first flight-line job inventories for the 326X2A, 326X2B, and 326X2C occupations were administered in April 1976). Even if available, Occupational Surveys would not have provided the required job content information. As discussed in some detail in a previous report,* the Air

*M. B. Carpenter, Maintaining Efficient Training Programs for Air Force Technical Specialties, The Rand Corporation, R-527-PR, September 1970, pp. 8-11.

Force's Occupational Surveys are not training oriented. In general, the information they gather concerns only the percent of people (at various skill levels and with various backgrounds) that perform a given task and the percent of time spent on that task in their current job. The translation of such an inventory into a training program is not obvious or, in most cases, straightforward. For example, on the flight line does the task "troubleshooting" require a knowledge of circuit analysis, Zener diodes, or video amplifiers? Does one need to know how test equipment works, or only how to use the test equipment? Perhaps "troubleshooting" consists only of operating the BITE (Built-In Test Equipment) and declaring an LRU defective if a light comes on or a meter reads too high or too low. To evaluate a training program, one must know if training adequately provides the knowledge and skills needed to perform the acts and make the judgments required on the job.

Of the several ways available for gathering job-related information--occupational survey, questionnaire, checklist, individual interview, and observation interview*--the Air Force rates the observation interview highest in terms of the specificity, completeness, and accuracy of the information

*See AFM 50-2. An observation interview is conducted at the work site and concerns the work being done at the time of the interview.

obtained, to wit "the observation interview is preferred because it reveals unique tasks and provides a better understanding of the work performed."* In many cases, this better understanding consists of an appreciation of the knowledge required for task performance, the most significant aspect of the task as far as training is concerned. This information can rarely be elicited in any but a face-to-face interview because of the potential variety of responses and because of the disinclination of most job incumbents for writing accurate descriptions of any length. As a result, a modified form of the observation interview was used in Rand's job content survey.

THE SURVEY POPULATION

Flight-line maintenance in F-111 (and F-15) Avionics Maintenance Squadrons is divided among three shops. The Bombing/Navigation shop maintains the navigation and weapon control equipment. Personnel assigned to that shop carry the 326X2A AFSC. The Instrument/Autopilot shop is responsible for flight controls, engine instruments, fuel indicators, and the autopilot. Airmen with 326X2B AFSC are assigned to this shop. Communications and Electronic Countermeasures (ECM) equipment is maintained by 326X2C personnel assigned to the Communications/ECM shop.

*AFM 50-2, p. 28 [emphasis added].

Personnel from one of the three shops are normally dispatched in teams of two or three to correct a system malfunction, which is usually reported by the aircrew during the postflight debriefing. To facilitate rapid maintenance action before an aircraft launch or immediately after an aircraft lands (while power is still applied to the various avionics systems), a special multishop team was established. At Cannon Air Force Base, this team is referred to as "Roadrunner."* The Roadrunner team, stationed on the flight line, has its own truck, carries its own spare LRUs, and is made up of experienced personnel from each shop. In effect, the Roadrunner unit acts as a fourth flight-line shop. Roadrunner duty places greater emphasis on treating the avionics system as an integrated whole and on quick turnaround action than does a conventional shop.

The remainder of this report describes how data were gathered to determine the job content of flight-line maintenance for advanced avionics systems and what analysis of that data showed. The report concludes with a general description of the job and its training implications. The complete interview summaries are included as an appendix because they provide specific explication of general points

*At Mountain Home Air Force Base, the team is known as Big D, the D standing for diagnostic, and at Plattsburg Air Force Base the team is called the Big Apple.

made in the text, illustrate the productivity of the flow-chart debrief technique, and can be used for analysis of additional issues, such as the results of the expert review of the interview data.

II. DESCRIPTION OF THE SURVEY

GENERAL STRATEGY

The primary goal of the survey was to describe flight-line maintenance accurately in terms of the knowledge and skills it requires, so that the nature of the needed training could be determined. Originally the study team planned to make direct observations of personnel in the course of their normal activity in all three shops plus Roadrunner to obtain the most accurate information. Trial runs would be conducted at several bases to test the feasibility of the approach and to develop effective procedures and forms for collecting the data. Attention would be concentrated on those tasks requiring substantial job knowledge and skills rather than on tasks of a less demanding nature such as cleaning and painting. After data collection, each job would be reviewed in detail by at least one job incumbent rated as an expert by his peers. These reviews would establish the completeness of the job description and the competence with which the job was performed, thus assuring that valid data would direct the team's final conclusions.

INITIAL DEVELOPMENT OF SURVEY PROCEDURES

In early January 1975, a Rand team visited the 474th Tactical Fighter Wing (F-111A) at Nellis Air Force Base for a general orientation to F-111 flight-line procedures and to

consider alternative approaches for conducting the job content survey. This visit was followed by a trip to the 27th Tactical Fighter Wing (F-111D) at Cannon Air Force Base in late January to test the feasibility of direct observation techniques. It soon became apparent that, in order not to disturb normal work patterns and to maximize the number of cases an interviewer could efficiently handle, the best approach was to debrief the maintenance team immediately after completion of a job. It was decided to test the debrief technique further at another F-111 base to avoid biasing the responses to be elicited at Cannon Air Force Base, where the study was to be focused. A three-day trial run was made in January with the 366th Tactical Fighter Wing (F-111F) at Mountain Home Air Force Base.

Following the test period at Mountain Home, data forms were prepared for use at Cannon. Figure 1 shows the field observation (supplemental data) form. The form was designed to record and duplicate the data normally recorded on Air Force Form 349. Later several comparisons will be made between the 349 data and the job content analysis data.

Figure 2 shows the main data collection instrument. The form was designed to allow the interviewer to record the exact sequence of steps performed by the maintenance team. The flow-chart nature of the form enabled the interviewer to record the logical decision/activity process. At each step, the form prompted the interviewer to inquire about the source

FIELD OBSERVATION FORM – SUPPLEMENTAL DATA

1. **Rand ID** _____

JCN _____

WC _____

A/C ID _____

System _____

Sortie _____

Narrative _____

_____

_____

Initial Instructions

Discrepancy

Corrective Action

2. 349 Data

	1	2	3	4	5
Type Maint					
WUC					
Action Taken					
When Disc					
How Mal.					
Units					
Start Time					
Stop Time					
Dispatch Time					
Return Time					

Crew Composition						
Man No.	S.L.					

Figure 1

FIELD OBSERVATION FORM – ACTIVITY SEQUENCE & KNOWLEDGE SOURCES

RAND ID _____ PAGE _____ MAN NUMBER _____ DATE ___/___/75___

- "Know how" sources;
- Relevant task background info;
- T.O. adequacy, if used.
- Ops Check - need detail.

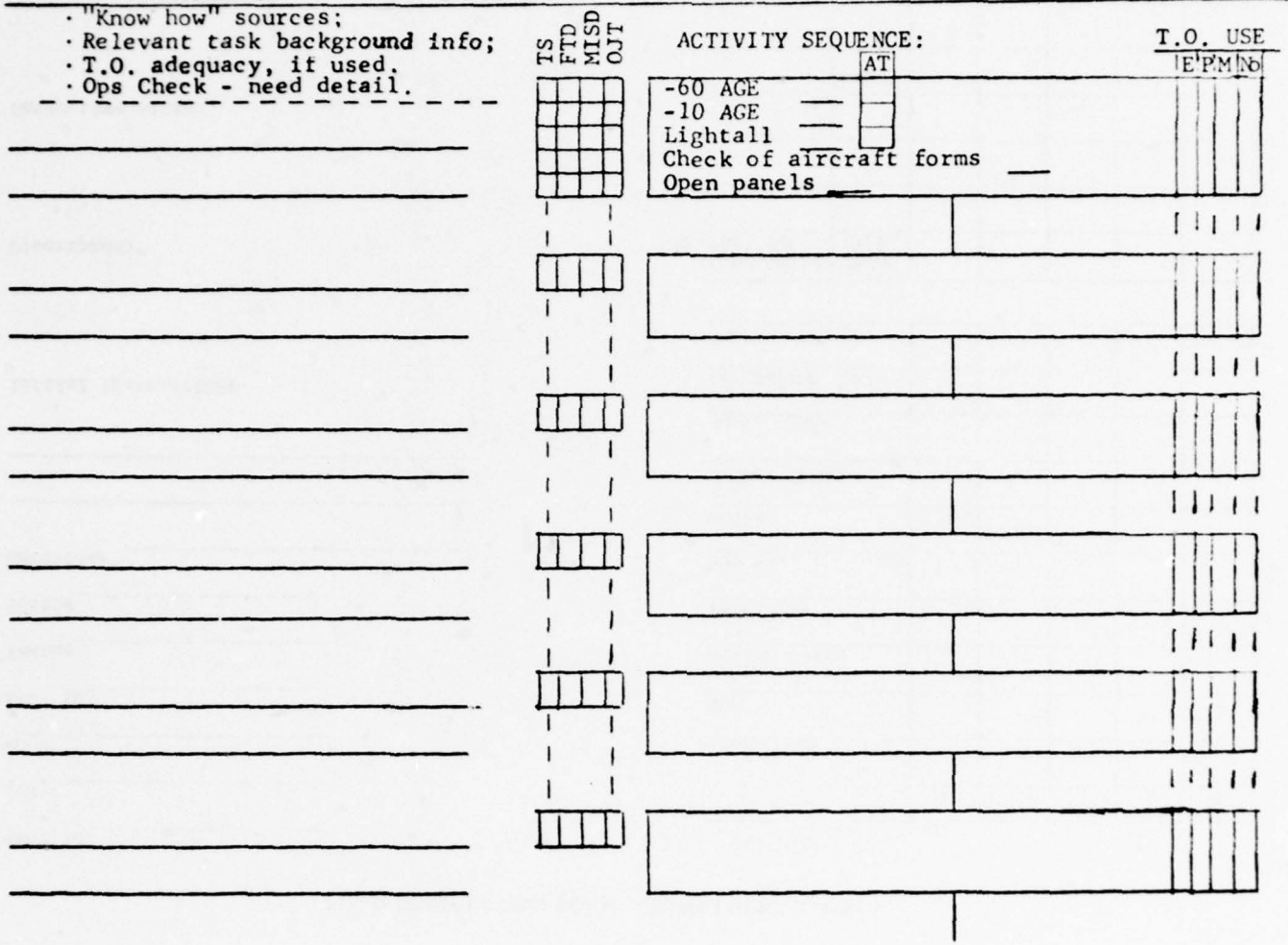

Figure 2

of knowledge to perform the step. Appropriate check boxes were provided at each step for knowledge received from one or more of the following: formal technical school (TS), Field Training Detachment (FTD) course, participation in the wing's own maintenance training (MISD), or on-the-job training (OJT) program. A record was also made of the extent to which technical orders (T.O.) were followed. The following categories were provided: complete and direct use (E), partial reference (P), from memory (M), and no direct reference or no use at all (No).

After completing the field observation form, the team prepared a summary form, as illustrated in Fig. 3. It provides for a narrative to accompany the flow chart and for a consolidation of the Form 349 data. A complete set of these final summaries may be found in the appendix.

CONDUCTING THE INTERVIEWS

The observation-debrief interviews were conducted at Cannon Air Force Base during the first two weeks of April 1975. Immediately after completing a maintenance assignment and the required 349 form, the maintenance crew joined the interviewer in a room adjacent to the flight-line shops. The interviewer copied the 349 data and indicated his desire to know, step by step, how the crew performed the assignment just completed. The activity sequence was drawn out by asking such questions as:

FIELD OBSERVATION SUMMARY

Page ___ of ___

Rand ID_____ Work Center_____ System_____

349 Data

	1	2	3	4	5
JCN					
TM					
WUC					
AT					
WD					
HM					
Start:					
Stop:					
Skill					

Activity Sequence

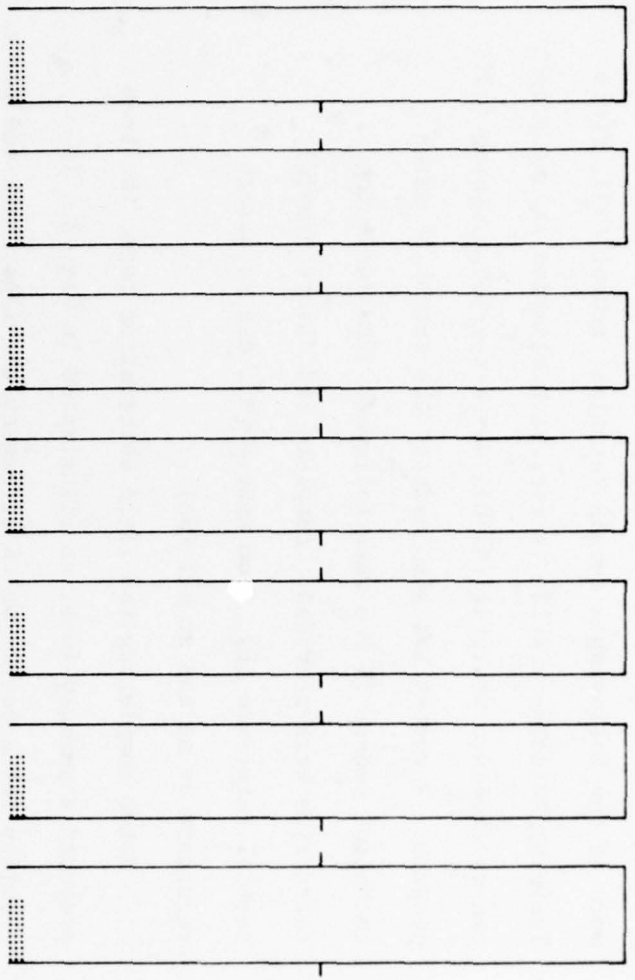

Figure 3

What did you do first? Why?

What did you do next? Why?

Have you left out any steps?

Did that complete the job?

After the Rand interviewer obtained the sequence of steps from start to finish, the interviewee was asked to comment on each step regarding his use of technical orders and where he learned to choose and perform that step. An example of a completed field observation form (supplemental 349 data and activity sequence) is provided as Fig. 4.

During the interview period, April 1 through April 11, 1975, the team completed a total of 141 interviews. Since some maintenance assignments consisted of more than one "job" (entry on the 349 form), the interviews yielded 188 entries--86 from Bomb/Nav, 39 from Instrument/Autopilot, 47 from Comm/ECM, and 16 from Roadrunner. When we refer to a "job," we mean one of these entries. Each entry includes one Work Unit Code (WUC, major system or LRU worked on) and one Action Taken (AT) code.

In May 1975, the Rand team revisited Cannon Air Force Base to validate the field observations. One (or more) experienced maintenance men (MM) from the appropriate shop was interviewed on each job write-up. With only two exceptions, the experts were sergeants with current flight-line experience. The experts were asked to comment on the completeness of the write-up and, based on the write-up, on

FIELD OBSERVATION FORM – ACTIVITY SEQUENCE & KNOWLEDGE SOURCES

RAND ID 130 PAGE 1 MAN NUMBER --- DATE 4 / 8 /75

- "Know how" sources;
- Relevant task background info;
- T.O. adequacy, if used.
- Ops Check - need detail.

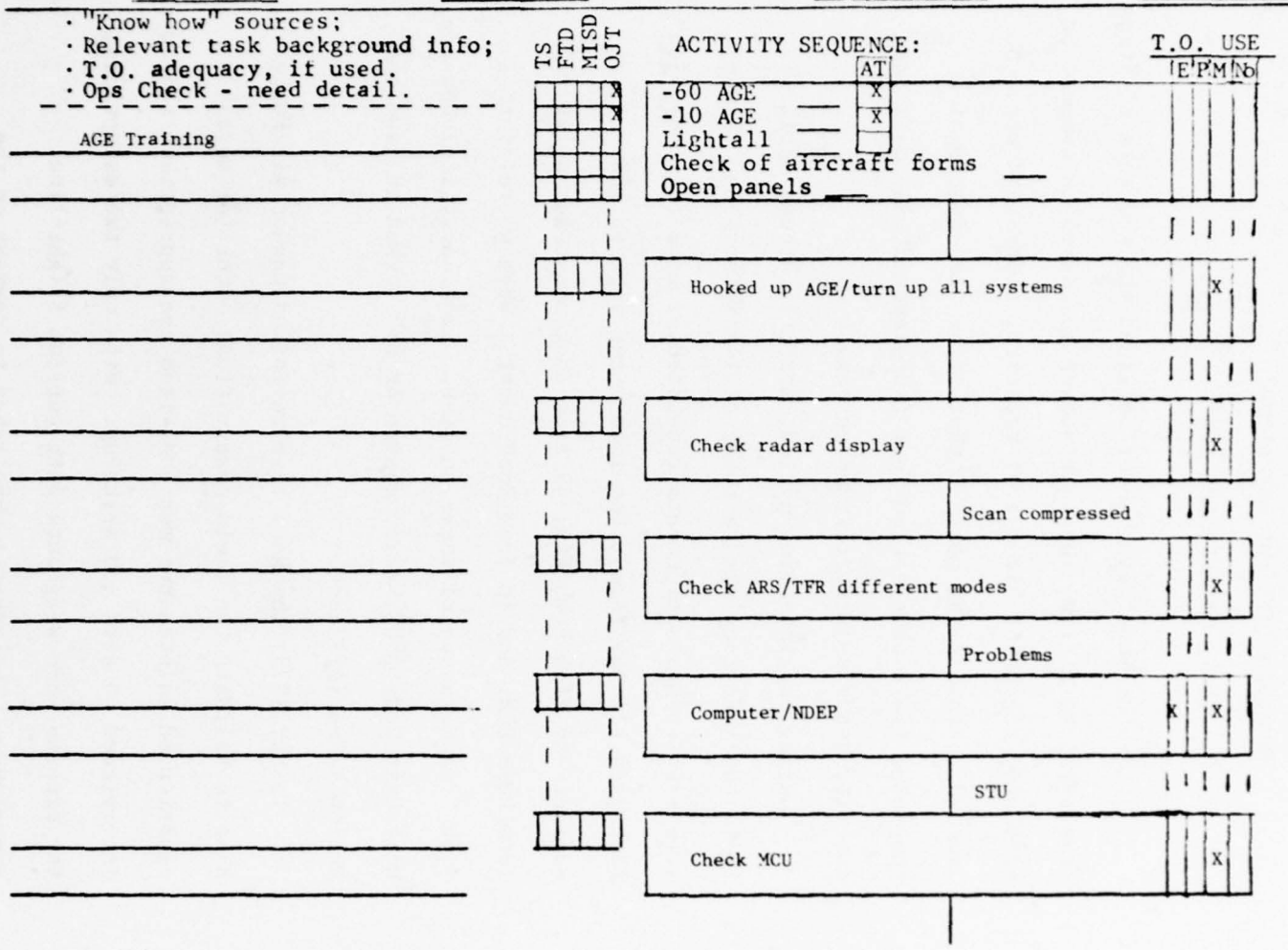

Figure 4

FIELD OBSERVATION FORM – SUPPLEMENTAL DATA

1. **Rand ID** 130

JCN 0910701

WC 24360

A/C ID 8138

System 73R

Sortie _____

Narrative _____

_____

_____

Initial Instructions

Discrepancy

ARS-TFR: No Scan Converter

Corrective Action

R/R STU

Ops Check good

2. 349 Data

	1	2	3	4	5
Type Maint	B				
WUC	73RCO				
Action Taken	R				
When Disc	D				
How Mal.	242				
Units	01				
Start Time	080400				
Stop Time	0600				
Dispatch Time					
Return Time					

Crew Composition	
Man No.	S.L.
	5

Figure 4--continued

the appropriateness of the actions taken. These comments are included in the final observation summaries under "Expert Comment."

In addition to the expert evaluation, the team tried to relate each recorded maintenance action to the original air-crew discrepancy report and subsequent maintenance actions. Specifically, we wanted to know if LRUs were found to be defective or serviceable when checked on the test stations and whether the original complaints reappeared on the flight subsequent to the maintenance action. Unfortunately, only slightly more than half of our jobs were listed on the "Debrief/AFTO 349 Reconciliation Report," and often these did not include subsequent shop actions. Even so, where available, we included the information on the field observation summaries under "Aircraft Followup."

Figure 5 presents the final field observation summary for the job (Rand ID 130) in Fig. 4.

REPRESENTATIVENESS OF THE JOB CONTENT SURVEY

A major concern of the Rand team was that the job content survey be representative of the normal work of the avionics flight-line shops. The interview-debrief techniques, followed by expert review, were designed to assure completeness and accuracy in recording the job content of those jobs surveyed. There was, however, no built-in a priori guarantee that the sample would be representative. The interviewers made it a

FIELD OBSERVATION SUMMARY

Rand ID 130 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0910701				
TM	B				
WUC	73 RCO				
AT	R				
WD	D				
HM	242				
Start:	080400				
Stop:	080600				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

No scan conversion was reported for ARS-TFR. MM. tracked the problem (see tasks 4 and 5) to the STU, which was replaced. The Tech. Order was consulted in tasks 4 and 7. Other tasks were done by memory. The procedures of tasks 4 and 7 were partially learned in FTD; remaining tasks were learned while on the job (OJ).

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

Test Station received the LRU and repaired it; "how mal" was "fails diagnostic/automatic test." No 73R write-up on next sortie.

Activity Sequence

1 Hooked up AGE

2 Turned on avionics systems.

3 Checked radar display visual

Scan compressed

4 Checked visually ARS-TFR displays in different modes.

Some problems

5 Addressed computer

Indicated a STU problem.

6 Checked MCU tape

Also indicated STU problem.

7 R&R STU

Figure 5

FIELD OBSERVATION SUMMARY

Rand ID 130 Work Center A Shop System 73R

Activity Sequence

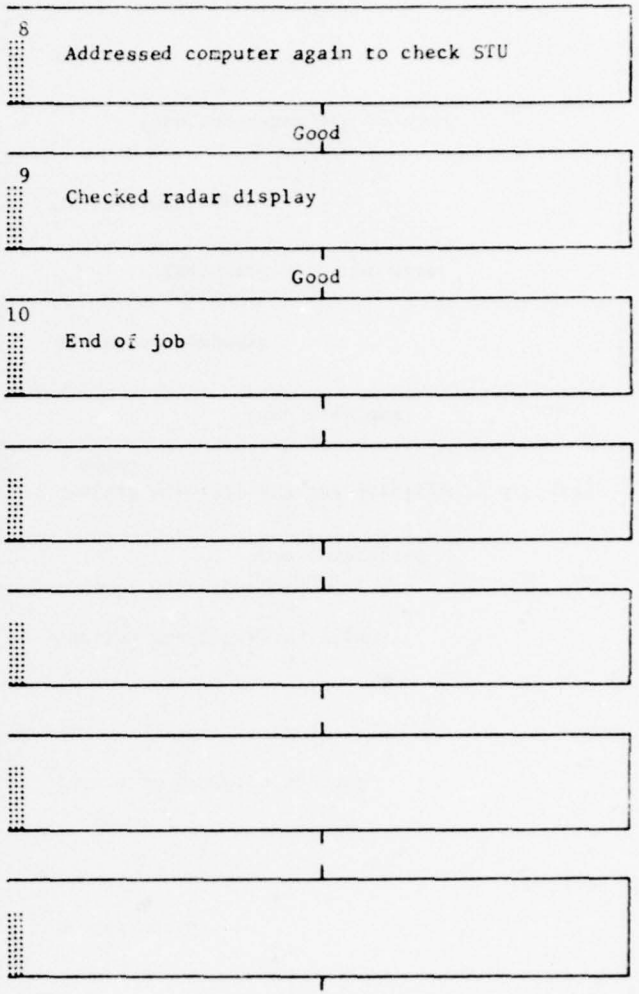

Figure 5--continued

point to work all shifts, but there was no attempt to prescreen interviews to insure a representative sample. To determine whether the sample was representative, the team checked the avionics subsystems involved in the survey observations against BLIS (Base Level Inquiry System) data for all of April 1975.

Table 1 shows the makeup of the sample by major avionics subsystem (usually an LRU), as recorded on the Form 349 extract.* Also shown are the totals for Cannon for the first two weeks of April 1975. Table 2 compares the frequencies with which avionics subsystems appeared in the job content survey and the BLIS data for all of April 1975. As noted previously, the sample did not include any maintenance actions with "general support" Work Unit Codes, and we deleted those from the BLIS data. Also shown are the percent of BLIS jobs that involved subsystems not appearing in the survey ("Others").

Although the team did not try to draw a representative sample, the frequencies shown in Table 2 are reasonably comparable for the jobs falling into the Bomb/Nav and Instrument/Autopilot shops. Communications/ECM jobs compare more poorly, possibly because of the large number of BLIS jobs on subsystems not appearing in the survey sample as well as maldistribution among those subsystems that did appear.

---

*The system codes are defined in T.O. 1F-111D-06. Also see Tables 4, 10, and 14 of this report.

Nevertheless, the sample of jobs in the most important shop, Bomb/Nav, and in Instrument/Autopilot, was sufficiently representative to allow us to draw general conclusions about the content of these jobs.

Table 1

NUMBER OF JOBS IN JOB CONTENT SURVEY BY SYSTEM, CANNON AIR FORCE BASE, APRIL 1-11, 1975

Bomb/Nav		Instrument/ Autopilot		Comm/ECM		Roadrunner	
System	No.	System	No.	System	No.	System	No.
73C	2	14A	1	61A	7	73H	5
73H	24	14E	1	61B	1	73K	1
73K	12	14H	7	61O	1	73P	3
73N	1	14O	1	63A	6	73R	1
73P	20	23Y	1			52A	2
73Q	3	46A	4	64B	1	52B	1
73R	10	51A	6	64O	1	61A	1
73S	14	51C	2	65A	4	63O	1
		51F	2	71B	4	64B	1
		51O	1	71C	5		
		52A	11	76D	5		
		52B	2	76K	6		
				76L	4		
				76M	2		
Sample total	86		39		47		16
Cannon total (April 1-11)	1004		432		314		135
% sampled	8.57		9.72		14.97		11.85

Table 2

FREQUENCIES OF AVIONICS SUBSYSTEMS APPEARING IN JOB CONTENT SURVEY AND IN BLIS DATA FOR APRIL 1975
(Percent)

Bomb/Nav			Instrument/Autopilot			Communications/ECM		
System	BLIS	Survey	System	BLIS	Survey	System	BLIS	Survey
73C	2.3	2.3	14A	0.4	2.6	61A	22.0	14.9
73H	23.0	27.9	14E	0.1	2.6	61B	2.1	2.1
73K	11.0	14.0	14H	14.1	17.9	61O	2.1	2.1
73N	2.8	1.2	14O	0.1	2.6	63A	5.8	10.6
73P	23.4	23.3	23Y	5.4	2.6	63O	0.5	2.1
73Q	5.0	3.5	46A	7.0	10.3	64B	6.4	2.1
73R	18.3	11.6	51A	17.4	15.4	64O	1.1	2.1
73S	12.6	16.3	51C	8.2	5.1	65A	3.9	8.5
			51F	7.6	5.1	71B	3.9	8.5
			51O	0.2	2.6	71C	3.4	10.6
			52A	22.1	28.2	76D	9.5	10.6
			52B	7.8	5.1	76K	10.3	12.8
						76L	5.9	8.5
						76M	9.3	4.3
Others[a]	1.5	0	Others	9.7	0	Others	13.7	0

[a] Subsystems not appearing in job content survey.

III. ANALYSIS OF THE JOB CONTENT SURVEY

The purpose of the job content survey was to make an accurate record of the major steps followed in the maintenance of avionics equipment on the flight line and to identify the decision aids used in performance of the job. The following discussion examines each shop separately to determine the nature of the job. Since most of the jobs fell in the Bomb/Nav shop and since maintenance of Bomb/Nav systems is more complex than maintenance of other systems (as we shall show), the discussion for the Bomb/Nav shop is more intensive.

BOMBING/NAVIGATION SHOP JOB CONTENT

The job sample for work in the Bomb/Nav shop included eight major systems. Table 3 shows the number of jobs on the various systems. The Roadrunner jobs on bomb/nav systems are included in the summary to insure that a more complete set of 326X2A jobs is analyzed.

The 96 bomb/nav jobs resulted in maintenance actions in the following eight work categories: AGE setup, troubleshoot, operational checkout, remove/install, minor repair, checking (less than full operational checkout), adjustment/alignment, and test/inspect. Table 4 gives the distribution of major maintenance actions by major system. For example, of the 29 73H (DCC/INS) jobs, 19 resulted in

Table 3

NUMBER OF BOMB/NAV JOBS BY MAJOR SYSTEM

Work Unit Code	System	Number of Jobs
73H	DCC/INS (Digital Computer Complex/Inertial Navigation System)	29
73K	TFR (Terrain Following Radar)	13
73P	ARS (Attack Radar System)	23
73Q	DRS (Doppler Radar System)	3
73R	IDS (Integrated Display Set)	11
73S	Data Panels and Controls	14
73C	AS (Altimeter Set)	2
73N	HSD (Horizontal Situation Display)	1
Total		96

some form of troubleshooting, five in an operational checkout, one in checking, and three in adjustment/alignment; there were 20 jobs with removal or installation actions, and on 16 jobs the maintenance crews set up the flight-line AGE. Since several maintenance actions can be taken on the same job, the total number of actions does not sum to the total number of jobs.

Table 4

BOMB/NAV SHOP JOB CONTENT: NUMBER OF JOBS WITH EACH TYPE OF ACTION BY SYSTEM

Type of Action	73H	73K	73P	73Q	73R	73S	Other	Total
AGE setup	16	1	8	2	2	7	2	38
Troubleshoot	19	7	16	1	7	4	1	55
Operational checkout	5	4	4	1	2	10	1	27
Remove/install[a]	20	6	16	2	9	12	2	67
Minor repair	0	1	0	0	0	0	0	1
Checking[b]	1	2	7	0	1	1	0	12
Adjust/align	3	2	0	0	0	0	0	5
Test/inspect	0	0	0	0	0	0	0	0
Total jobs	29	13	23	3	11	14	3	96

[a] This statistic counts each removal or each installation (R/I) as one action, thus "remove and replace" is two R/I actions.

[b] Less than full operational checkout.

The most significant maintenance actions observed in the job survey were troubleshoot or operational checkout. (AGE setup primarily involves supplying external power to the aircraft and will not be discussed further.) Troubleshooting, involved in 57 percent of the jobs, is any action undertaken to isolate the cause of a discrepancy. Generally it leads to

the replacement of an LRU, i.e., a remove/install action. In a small number of cases, the LRU is adjusted or calibrated without removal from the aircraft. An operational checkout (or ops checking) is the following of a prescribed procedure to verify that a system is performing properly. It generally follows troubleshooting and the installation of an LRU or a repair, align, adjust, or calibration action. Twenty-eight percent of the jobs involved ops checking.

The least prevalent job actions were repair, check, align, and inspect; they occurred in only 17 percent of the jobs. Table 5 presents the 16 jobs in these job categories. (On two jobs--25 and 127--two minor actions occurred.) In most cases they were routine and undemanding activities.

The troubleshoot category, in terms of the frequency with which it is performed and in its requirement for job knowledge, is by far the most important for maintaining the aircraft in good working order. As part of the job content analysis, the Rand team was particularly interested in the techniques used to perform these tasks. Table 6 presents the major diagnostic techniques used in the 55 troubleshoot jobs. Although specific techniques differ by type of system, the major patterns are clear. On average, nearly two diagnostic techniques were used on each troubleshooting job. The diagnostic technique used in most jobs is addressing the computer through the Navigational Data Entry Panel (NDEP) and observing the numerical readout. This procedure uses the

Table 5

BOMB/NAV SHOP ACTIONS IN MINOR REPAIR, CHECKING, ADJUST/ALIGN, AND TEST/INSPECT

System	Action	Rand ID No.
	Minor repair	
73K	Replaced fuse	25
	Checking[a]	
73H	Equipment clock	92
73K	Fuse conditions	25
	Frequency separation (TFR)	127
73P	Inertial navigation system (INS) tolerance	2
	Maintenance control unit (MCU) tape operation	22
	Air-to-air ranging tolerance	100
	Continuously computed impact point (CCIP) (by partial simulation)	101
	Circuit breakers, equipment clock	125
	Antenna torque	137
	Pressure check	204
73R	Right designator cursor display	16
73S	Switch condition	53
	Adjust/align	
73H	Correct switching error	3
	Calibration of ARS range markers	206
	Reset circuit breakers	44
73K	Angle-of-attack display	55
	Tuned TFR antenna/receiver channels	127

[a] Less than full operational checkout.

Table 6

NUMBER OF BOMB/NAV TROUBLESHOOTING JOBS WITH EACH TYPE OF DIAGNOSTIC TECHNIQUE

Diagnostic Technique	73H	73K	73P	73Q	73R	73S	Other	Total
Computer addressing	17	0	13	0	2	1	0	33
Built-in test	5	5	5	1	0	1	1	18
Video or display observation	0	4	7	0	7	3	1	22
Audio observation	0	3	0	0	0	0	0	3
Maintenance control unit	0	0	0	0	1	0	0	1
Diagnostic remove and install	10	2	8	0	5	0	0	25
	(43)[a]	(4)	(16)	(0)	(21)	0	0	(84)
Special test equipment	0	1	0	0	0	0	0	1
Number of different jobs	19	7	16	1	7	4	1	55

[a] Numbers in parentheses are actual number of R/I actions.

computer memory's ability to retain information on LRU malfunction. The technical order contains numerical input codes--error trap addressing--for the various systems and output codes with a list of likely LRU failures. This technique, however, was not always part of official troubleshooting procedures. Computer memory address codes were originally used in the development of the computer

programs (software) by the contractor's systems programmers and were first published only in the operational checkout manual for aircrews. Through local usage at Cannon, the codes have become an accepted flight-line troubleshooting procedure and were recently incorporated in provisional maintenance technical order revisions.

Unfortunately, however, the computer does not provide an unambiguous fault isolation capability. Often more than one LRU can be responsible for a given computer readout code, and further diagnostic aids must be used. Individual judgment is needed in the selection of the appropriate code and in the interpretation of the computer readout. Knowledge of system integration and system data flow is required to utilize this diagnostic technique properly.

After diagnostic R/I, the next most common diagnostic technique was the interpretation of video and other displays. These procedures usually require a high degree of judgment and knowledge of how the integrated avionics components are tied together. Improper output display could be caused by the display unit itself, the computer, the sensor device, or the wiring. This technique is analogous to troubleshooting a home television set when the main indication is the quality of the picture.

Operation of the BITE and the Avionics Test Panel (ATP) also constitutes a major troubleshooting technique. Either automatically or in response to a test initiated by the

aircrew or maintenance personnel, the BITE causes a fault legend light to appear on the ATP or a meter to deflect and reveal the operational status of an LRU. Although the tests are simple to operate, like computer addressing they can lead to ambiguous or incorrect conclusions regarding LRU status. Usually the BITE/ATP indication is verified by replacing one of the indicated LRUs.

Use of the BITE system was designed to go hand in hand with the MCU. According to the Attack Radar and Terrain Following Radar System Technical Manual, "Troubleshooting ... consists of observing FAILURE STATUS lamps on the AVIONICS TEST PANEL and reading the printout of the MCU ... to determine malfunctions.... [However], further troubleshooting may be performed if built-in tests do not isolate to the malfunction."*

The MCU is a unique diagnostic aid on the Mark II avionics system. The system is designed to print fault codes indicating specific LRU failures. It is used as part of the BITE system and complements the ATP fault legend. However, the MCU is not always reliable. The F-111 technical order notes, "MCU printouts may occur due to hard LRU failure, as well as faulty interconnect wiring, intermittent LRU malfunction, or momentary interference in the aircraft wiring or power."**

*T.O. IF-111D-2-19, p. 4-4B.
**T.O. IF-111D-2-5-2-1, p. 2-4.

The survey showed that the MCU is not being widely used as a diagnostic aid. It was mentioned in only two jobs, once as a diagnostic aid and once as an LRU to be repaired. In the latter case, it was repaired last, instead of first, when it might have been used in troubleshooting other systems. The MCU printout is not used because the airmen have found that many of the printouts reflect transient malfunctions and cannot be relied upon to pinpoint LRU failure.

The use of the MCU by flight-line personnel is directly related to their evaluation of the quality of MCU information as an aid in troubleshooting. Because of generally poor fault isolation capability on the Mark II/F-111D, the F-111 Special Projects Office contracted with General Dynamics for an investigation of fault isolation on the F-111D. This resulted in early 1974 in the Fault Isolation Verification Program (FIVP). General Dynamics concluded that,*

> The fault isolation capability has been found inadequate because:
>
> 1. Avionics Test Panel (ATP) legends and Maintenance Control Unit (MCU) printouts occur indicating failures when no faults are present in the system.
>
> 2. Faults occur which are not indicated by the ATP and/or MCU printouts.
>
> 3. Failures occur and the incorrect Line Replaceable Unit is indicated as faulty.

*F-111D MK II Fault Isolation Verification Program (FIVP), Final Report: Volume I. Analysis, FZM-12-8308, General Dynamics Convair Aerospace Division, 1 July 1974, pp. 1-4.

4. The flight-line technical orders and special troubleshooting are incomplete or erroneous in many cases.

The removal and installation (R/I) of an LRU is not only the culmination of troubleshooting but in many cases is a diagnostic technique itself. A diagnostic R/I sometimes consists of using an available spare from supply or the shop to confirm a malfunction. When spares are not available, LRUs are swapped between aircraft, the presumably good LRU being returned to the original aircraft after confirmation of the malfunction. In some cases, when spares are not available and swaps are made, LRUs are removed and sent to the shop on the basis of a best guess, without strong supporting information.*

The job content survey indicated that (1) there is a significant underreporting of remove or install actions in official Air Force data, and (2) a majority of R/I actions are for diagnostic purposes. Table 7 compares Air Force data from Form 349 with data collected as part of the job content

*Examples of diagnostic R/I occurred in both the job content survey and FIVP. For example, in the appendix see Rand ID 19 for multiple R&R actions and ID 14 for "best guess removal." As part of FIVP, the team first "substituted EPU [Electronic Processor Unit] even though a sequenced test indicated all LRUs GO. (Borrowed EPU from A/C 68-177. Borrowed EPU had same indications as EPU originally installed on AC 68-176)." Since the problem could also be caused by the MRU, that unit was removed. The expert comment was, "The troubleshooting for this type problem was by the process of elimination (MCU/ATP/computer readouts were of no assistance). When MRU replaced in A/C, problem cleared." FIVP Final Report: Volume III. Appendix M, pp. M-138-139.

Table 7

NUMBER OF BOMB/NAV REMOVE AND INSTALL ACTIONS BY SYSTEM

System	Survey Jobs		R/I Actions[a]	
	Total	No. with R/I Actions	By Form 349 Records	By Job Content Survey
73H	29	20	27	65
73K	13	6	8	10
73P	23	16	31	32
73Q	3	2	2	2
73R	11	9	13	25
73S	14	12	13	14
Other	3	2	4	3
Total	96	67	98	151

[a] Each R/I (removal or installation) is counted as one action (e.g., a "remove and replace" is taken as two R/I actions).

survey. Of the 96 bomb/nav jobs included in the survey, 70 percent contained at least one R/I action. The Form 349 data showed 98 separate R/Is; the job content survey revealed 151 such actions, an undercount of 35 percent. (This is a conservative estimate because swaps were counted only on the receiving aircraft. Unfortunately, a fuller count is not possible because the survey did not consistently record swaps.)

A majority of the R/I actions in the job content survey (58 percent) were for diagnostic purposes, as shown in Table 8. Forty-five percent of the troubleshooting jobs used the diagnostic R/I as an important troubleshooting technique. On these jobs an average of 3.5 remove or install diagnostic actions was recorded. The R/I average is 1.82 on troubleshooting jobs where no diagnostic R/Is were performed.*

The prevalence of R/I actions for diagnostic purposes has important implications for maintenance and requirements for spare LRUs. Exchanging LRUs for spares can be very time-consuming, with time lost waiting for spares to be delivered to the flight line. If deliveries are made through normal supply channels, the wasted time can be significant. (The use of a forward flight-line supply distribution point initiated at Cannon Air Force Base reportedly reduced wait time for spares considerably.)

If spares are not available, which happens frequently, a diagnostic R/I often involves borrowing an LRU from another aircraft. Such actions generate additional work on the lending aircraft and greatly increase the wear and tear on the LRUs themselves. In addition, there is always the possibility that the borrowed LRU is itself malfunctioning, so that the diagnosis it provides will be faulty.

---

*The overall R/I average on nontroubleshoot jobs was 0.50, and on jobs with R/Is the average number of R/I actions was 1.08.

Table 8

NUMBER OF BOMB/NAV REMOVE AND INSTALL ACTIONS BY TYPE OF JOB

Type of Job	Number of Jobs	Total R/Is	Diagnostic R/Is
Troubleshooting with R/Is	42	123	88[a]
Operational checkout with R/Is	14	16	--
Other jobs with R/Is	11	12	--
Jobs without R/Is	29	--	--

[a] Diagnostic R/I occurred on only 25 of the troubleshooting jobs. The total R/Is for diagnostic purposes on these 25 jobs was 88.

Because of the importance of R/I as a diagnostic technique, maintenance personnel should be thoroughly trained in its use; this is discussed in more detail in the concluding section.

In the next section, we discuss at some length the effects of the integrated nature of advanced avionics on flight-line maintenance. Here, we need only note that the Mark II is the prime example of an integrated avionics system and that the effects of system integration are particularly

evident in the Bomb/Nav shop. Although we speak in terms of individual systems such as the Attack Radar System (ARS), the Integrated Display Set (IDS), or the Digital Computer Complex (DCC), malfunctions often occur in several systems at once. For example, on one job (interview ID 105) problems were encountered on the following five major systems:

- The Data Panels and Controls
- Inertial Navigation Set
- Terrain Following Radar Set
- Altimeter Set
- Attack Radar Set (Electronic Processor Unit)

This is not unusual. In fact, malfunctions in one system often appear to affect the performance of totally different systems. Of the 76 work assignments on Mark II systems on which we obtained interviews (including 9 from Roadrunner), 22 indicated intersystem effects other than the use of the computer for diagnostics.*

So far the discussion has concentrated on major diagnostic techniques used by bomb/nav personnel to troubleshoot the Mark II system. Equally important is the identification of diagnostic techniques not used. Forty-four

*Intersystem effects are suggested on the following field summaries (see the appendix): ID 2, 13, 15, 17, 19, 22, 25, 44, 45, 71, 75, 87, 90, 105, 108, 110, 124, 125, 126, 130, 137, and 205.

percent of a 326X2A's technical school training is in basic electronics. The job content survey, however, revealed that diagnostic techniques requiring basic electronics, compared with those requiring a thorough knowledge of the integrated avionics system itself, were rarely used. This was hardly a surprise given the design of the LRUs, which, for most purposes, can be viewed as sealed containers. Flight-line maintenance personnel do not have access to the internal circuitry of the LRU. In fact, in only one case (summary ID 105) was a knowledge of basic electronic principles used. In that case, a technical representative from General Dynamics used a breakout box* and an oscilloscope to examine wave forms associated with a Terrain Following Radar problem. Most 326X2As do not have the training or experience to use an oscilloscope properly, nor do they have access to a breakout box.

The use of a breakout box, together with added knowledge and training, could provide additional flight-line diagnostic capability. However, breakout box use by Air Force personnel was explicitly recommended against by the General Dynamics FIVP. It stated in part:**

> No known maintenance action justifies use of breakout boxes for other than engineering analysis. Recommend

*A breakout box is a connection device that gives access to internal test points.

**FIVP Final Report: Volume III. Appendix M, p. M-327.

> use of the breakout boxes for engineering analysis only, and not for standard flightline troubleshooting. The reasons for not using breakout boxes are:
>
> 1. Other equipment must be carried to flight line.
>
> 2. A breakout box requires a PSM-6 (VOM meter) or oscilloscope that requires external power.
>
> 3. LRU substitutions usually easier and more reliable.
>
> 4. Experienced technical representatives quickly available.
>
> 5. Additional training needed to use breakout box.

The tenuous connection between basic electronics and flight-line troubleshooting was also made clear by the responses of 326X2A personnel to a TAC questionnaire in 1974. Although opinions were not uniform, the majority were critical of the teaching of basic electronics and the lack of opportunity for using that knowledge on the job. For example, one airman assigned to the 27th Tactical Fighter Wing at Cannon said,

> Actually, it [electronic fundamentals] was a waste--not that the training itself is at fault, but rather the career field. Electronics is not utilized. [We] went too deeply into wiring diagrams, etc., for doing this job. Somebody evidently is still pretending that the 326X2A career field involves electronics, and it doesn't. No more so than turning on a light switch would involve working on a generator. [Emphasis added.]

In summary, the key to effective and efficient maintenance in the Bomb/Nav shop is the ability of the man to make use of all diagnostic tools to increase the accuracy of

diagnosis and to decrease the time expended on maintenance actions. Choosing the appropriate sequence of actions is the most demanding aspect of bomb/nav maintenance. Although designed to indicate the systems at fault quickly and clearly, the Mark II avionic system's diagnostic aids do not provide unequivocal information. Thus, the bomb/nav maintenance man must play detective, developing clues and interpreting them as he works through a mix of diagnostic techniques in his search for the one or more defective LRUs, or to insure that the system is fully operational.

INSTRUMENT/AUTOPILOT SHOP JOB CONTENT

The job sample for work in the Instrument/Autopilot shop involved 12 major systems. Table 9 shows the number of jobs on the various systems. Roadrunner jobs on instrument/autopilot systems are included in the summary to insure that a more complete sample of 326X2B jobs is analyzed.

The 42 Instrument/Autopilot shop jobs resulted in maintenance actions in the following nine categories: AGE setup, troubleshoot, operational checkout, remove/install, minor repair, checking, adjust/align, test/inspect, and safety wiring. Table 10 gives the distribution of major maintenance actions by major system. The various maintenance actions are not mutually exclusive and do not necessarily sum to the total number of cases.

Table 9

NUMBER OF INSTRUMENT/AUTOPILOT JOBS
BY MAJOR SYSTEM

Work Unit Code	System	Number of Jobs
14A	Flight Control, YAW Channel	1
14E	Flight Control, SLAT System	1
14H	Flight Control, General	7
140	Flight Control	1
23Y	Turbojet Power Plant (TF30), Engine Instrumentation	1
46A	Fuel System, Fuel Quantity	4
51A	Instruments, Flight and Navigation	6
51C	Instruments, Auxiliary Flight Reference System	2
51F	Instruments, Pitot-Static System	2
510	Instruments	1
52A	Autopilot, Automatic Flight Control Systems	13
52B	Autopilot, Central Air Data Computer	3
Total		42

Table 10

INSTRUMENT/AUTOPILOT SHOP JOB CONTENT:
NUMBER OF JOBS WITH EACH TYPE OF ACTION BY SYSTEM

Type of Action	14H	46A	51A	52A	52B	Other	Total
AGE setup	2	2	2	4	1	4	15
Troubleshoot	0	3	2	6	2	5	18
Operational checkout	5	0	3	6	1	1	16
Remove/install[a]	6	1	2	8	3	4	24
Minor repair	0	0	1	0	0	1	2
Checking[b]	1	2	1	2	0	2	8
Adjust/align	0	0	2	0	0	0	2
Test/inspect	0	0	0	1	0	0	1
Safety wiring	3	1	0	2	0	0	6
Total	7	4	6	13	3	9	42

[a] This statistic counts each removal or each installation (R/I) as one action; thus "remove and replace" is two R/I actions.

[b] Less than full operational checkout.

Like the bomb/nav work, the most significant maintenance actions observed in the job survey were troubleshooting and operational checkout. Troubleshooting was involved in 43 percent of the jobs; ops checking in 38 percent.

The more routine and less demanding activities of repair, check, adjust, align, inspect, and safety wiring occurred in 38 percent of the jobs. (Safety wiring entails inserting steel wires in screws or cannon plugs to insure that they remain secured; no electronics knowledge is involved, but the operation does require some manual dexterity.) Table 11 presents the 16 jobs in these job categories (three--33, 132, and 133--had two minor actions each).

The troubleshoot work category is by far the most important, in terms of frequency performed, for maintaining the aircraft in good working order and for requiring job knowledge. As part of the job content analysis, the Rand team was particularly interested in the techniques used to perform these tasks.

Table 12 shows the major diagnostic techniques used in the 18 troubleshooting jobs. Clearly, the Instrument/ Autopilot shop does not use the range of diagnostic techniques available to the Bomb/Nav shop. Most notably, the computer is not used as a diagnostic aid, nor is the diagnostic R/I widely used. The BITE is the only standard diagnostic aid employed, and that is primarily with the

Table 11

INSTRUMENT/AUTOPILOT SHOP ACTIONS IN MINOR REPAIR, CHECKING, ADJUST/ALIGN, AND TEST/INSPECT

System	Action	Rand ID No.
	Minor repair	
23Y	Put range markings on tachometer indicator	27
51A	Replace wires on inclinometer	132
	Checking[a]	
14H	Control stick button	37
46A	Fuel quantity tolerances	96
	Fuel probes (visual)	133
51A	Barometer seal (visual)	33
51F	Pitot tube (visual)	128
52A	Circuit breakers	107
	Feel and trim (physical)	118
140	Assist other shop--move aircraft flight controlss	39
	Adjust/align	
51A	Inclinometer	132
	Barometer	33
	Test/inspect	
52A	Flight control	65
	Safety wire	
14H	Control stick	30,36,119
46A	Fuel probe	133
52A	Roll rate gyro	47,72

[a] Less than full operational checkout.

Table 12

NUMBER OF INSTRUMENT/AUTOPILOT TROUBLESHOOTING JOBS WITH EACH TYPE OF DIAGNOSTIC TECHNIQUE

Diagnostic Technique	14H	46A	51A	52A	52B	Other	Total
Built-in test	0	0	0	5	1	1	7
Video observation (Horizontal Situation Indicator)	0	0	1	0	0	1	2
Other visual observation[a]	0	2	1	0	1	2	6
Diagnostic remove and install	0	0	0	1	0	0	1
Special test equipment	0	1	0	0	0	1	2
Number of different jobs	0	3	2	6	2	5	18

[a] Lights, indicators, or equipment condition.

Automatic Flight Control System and Central Air Data Computer (52A and B) systems. In most cases, an evaluation of the system's performance in normal operation is the primary method for identifying defective LRUs. Note also that in the sample only one diagnostic technique was used per troubleshooting job.

In Rand summaries ID 34 and 129, a test set and multimeter were used to test the fuel quantity system and slats, respectively. Although the design of the test equipment

requires a knowledge of electronic theory, its use entails only that the technician read a dial to judge tolerances. In effect, the meters are used to indicate go/no-go situations, and the dial presentations could be so redesigned. The analog from civilian life is the commercial vacuum tube tester. Although the tube tester is a precision measuring device, it is easy to set and provides an easily understood good/bad readout. Such devices permit novices to check vacuum tubes adequately.

COMMUNICATIONS/ELECTRONIC COUNTERMEASURES SHOP JOB CONTENT

The job sample for work in the Comm/ECM shop involved ten major systems. Table 13 shows the number of jobs on the various systems. Roadrunner jobs on comm/ECM systems are included in the summary to insure that a more complete sample of 326X2C jobs is analyzed.

The 50 jobs resulted in maintenance actions in seven work categories. Table 14 shows the distribution of major maintenance actions by major systems. (Four systems that appear only once each in the data sample are not included.) The various maintenance actions are not mutually exclusive and do not necessarily sum to the total number of cases.

The more routine and less demanding activities of repair, check, adjust, and align occurred in 24 percent of the jobs; Table 15 shows the 12 jobs in these categories.

As with the other shops, the team was particularly

Table 13

NUMBER OF COMM/ECM JOBS BY MAJOR SYSTEM

Work Unit Code	System	Number of Jobs
61A,B&O	HF Receiver/Transmitter	10
63A&O	UHF Receiver/Transmitter	7
64B&O	Intercommunication	3
64K		
65A	Air-to-Ground Interrogation, Friend or Foe (IFF)	4
71B	Tactical Air Navigation (TACAN)	4
71C	Instrument Landing System (ILAS)	5
76D	ECM Radar Receiver	5
76K	ECM Set	6
76L	ECM IR Receiver, AAR-34	4
76M	ECM IR Receiver, AAR-41	2
Total		50

Table 14

COMM/ECM SHOP JOB CONTENT: NUMBER OF JOBS WITH EACH TYPE OF ACTION BY SYSTEM

Type of Action	61A	63A	64B	65A	71B	71C	76D	76K	76L	76M	Total
AGE setup	2	2	0	2	0	2	2	1	4	0	15
Troubleshoot	4	4	2	3	1	1	1	2	4	0	22
Operational checkout	1	2	1	0	2	2	1	1	0	0	10
Remove/install[a]	9	5	0	3	1	1	2	5	0	2	28
Minor repair	0	0	1	0	0	0	0	0	0	0	1
Checking[b]	2	4	0	2	0	0	0	0	0	0	8
Adjust/align	0	0	1	0	0	0	0	0	2	0	3
Number of different jobs	8	6	2	4	4	5	5	6	4	2	46

[a] This statistic, in this survey, counts each removal or each installation (R/I) as one action; thus "remove and replace" is two R/I actions.

[b] Less than full operational checkout.

Table 15

COMM/ECM SHOP ACTIONS IN MINOR REPAIR, CHECKING, ADJUST/ALIGN, AND TEST/INSPECT

System	Action	Rand ID No.
	Minor repair	
64B	Temporary cord installation	1
	Checking	
61A	Control box light	59
	Broken knob	103
63A	Air pressure with gauge	29
	Broken knob	102
	Circuit breakers and fuses	85,202
65A	Incorrect IFF installation	112
	Circuit breakers, wiring	212
	Adjust/align	
64B	Interphone cords	9
76L	Recycle IR system	40,115

interested in the techniques used to troubleshoot the comm/ECM equipment. Troubleshooting is the second most frequently performed task, occurring in 48 percent of the jobs. It is the most important for maintaining the aircraft in good working order and in the knowledge required for the job. Table 16 presents the major diagnostic techniques used in the 22 troubleshooting jobs. Note that the Comm/ECM shop uses fewer diagnostic techniques than does the Bomb/Nav shop and that only a little more than one technique was used on the average job.

The built-in test equipment is used primarily for ECM systems; the main diagnostic technique for troubleshooting the communication systems is to try to operate them in their normal manner and to listen to the quality of the audio.

Special test sets, whose operation is specified step-by-step in the technical orders, are used to test the ultrahigh frequency (UHF), ILAS, and TACAN systems. In one case, the set provides a go/no-go indication; in the other two, the technician observes and interprets displays in the aircraft that are activated by the the set. A multimeter is sometimes used to check tolerances (again, go/no-go) printed in the technical orders. Use of the test sets and the multimeter requires ability to follow the technical orders and to interpret displays, not knowledge of basic electronics.

The survey of the Comm/ECM shop contained instances in

which avionics system malfunctions crossed the division between this shop and the Bomb/Nav shop. Both the TACAN and the ILAS, for example, can be affected by failures in bomb/nav systems, as illustrated in summary ID 60.

Table 16

NUMBER OF COMM/ECM TROUBLESHOOTING JOBS WITH EACH TYPE OF DIAGNOSTIC TECHNIQUE

Diagnostic Technique	61A	63A	64B	65A	71B	71C	76D	76K	76L	Total
Built-in test	1	0	0	2	0	0	1	2	3	9
Audio observation	1	2	2	2	0	0	0	0	0	7
Video observation	0	0	0	0	0	0	1	0	0	1
Diagnostic remove and install	4	0	0	2	0	1	0	0	0	7
Special test equipment	0	2	0	1	1	0	0	0	0	4
Number of different jobs	4	4	2	3	1	1	1	2	4	22

IV. CONCLUSIONS

The job content analysis allowed the team to draw several conclusions about the nature of flight-line maintenance. While these conclusions are most valid for the F-111D, visits to Nellis (F-111A), Langley (F-15) and Plattsburg (FB-111A) Air Force Bases, together with the initial data collection and pretest at Mountain Home Air Force Base (F-111F), indicate that these conclusions are applicable to avionics maintenance in general.

As background for the conclusions, we first describe the effect of systems integration on the operation of avionics systems and on fault isolation. Next, we characterize the nature of flight-line maintenance in the three integrated avionics shops. Finally, we draw some implications for training.

SYSTEMS INTEGRATION

All avionics systems can be thought of as consisting of sensors, computational devices (analog or digital computers), and functional control and display units. Spurred by advances in computer technology, avionics systems have progressed from simple "redundant" systems, employing separate sensors and computational and display units for each function, to complex integrated systems. The first, and simplest form of integration combined all computational

requirements in a single executive computer. With the advent of powerful digital computers, the next step was to provide separate analog or digital converters for each sensor. The present state of the art, incorporated in the Mark II, provides a central data converter and computer complex.

The increased capability of integrated avionics systems and the central role the computer plays in such systems are illustrated by the following:*

> [In modern tactical aircraft systems] navigational computations based on inputs from airborne sensors, inertial platforms and radio aids ... become more complex as demands for inflight alignment, filtering, smoothing errors, inflight calibration, inflight compensation for temperature differential[s] ... become more prevalent. When terrain avoidance is introduced, the computer problems [become] the largest hurdle, since optimum choices must be made.... Attack radar provide[s] inputs that require coordinate conversion and close coupling to navigation computation[s]; i.e., radar and navigation sections of the computer "talk" to each other. The display "freeze," so important to improved identification of objects and to improve[d] accuracy with which cross hairs fix a target, would not be possible without the computer. The computer must also calculate target position for offset.
>
> Accurate control of strike using bombs or missiles [is] also a computer function, since all data on present position, velocity, ballistics and air data go to the computer. Attack computations in air-to-air engagements are also computer functions.

As shown previously, malfunctions often occur in several systems at once in the Mark II, the foremost example of an

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*See: Harry I. Davis, "Military Avionics--How Much Integration?", Astronautics and Aeronautics, Vol. 5, No. 6, June 1967, p. 53.

integrated system. In addition to the examples in our data, Table 17 shows the number of system malfunctions per sortie flown by just one aircraft as part of the General Dynamics FIVP test program. In this program also, as in the job content survey, malfunctions in one system affected the performance of totally different systems. For example, Table 17 shows an ARS malfunction on flight 13. The ARS discrepancy was "ARS video weak and lost sweep on ground." The FIVP team found that "weak video seemed to be related to STU (Signal Transfer Unit, an LRU in the Integrated Display Set)." However, an EPU (an LRU in the ARS) was removed because "malfunction seems to indicate that the EPU was failing intermittently." On a previous flight, the FIVP team attributed this same discrepancy to a bad MSD (Multi-Sensor Display, another LRU in the Integrated Display Set).

The problems caused by the high degree of integration in advanced avionics systems are even more critical because, unlike the maintenance of previous avionics systems, F-111 avionics require flight-line technicians to rely on the fault isolation capability built into the system. If the BITE provided unambiguous indications of LRU failure, the job would be easy and routine. Such is not the case. At the end of the FIVP test program, General Dynamics concluded that "there are many system problems including intermittent malfunctions, each with a low frequency of occurrence

Table 17

FIVP AIRCRAFT 68-150: NUMBER OF MALFUNCTIONS
(Number of Writeups)

Flight Number	Malfunctioning System[a]									Total Reports
	ARS	DRS	IDS	DCC	INS	HSD	SMS	MCU	OFP	
1			1							1
2					1					1
3										0
4								1		1
5	1			1						2
6	1									1
7			1							1
8			3							3
9				1						1
10					1					1
11		1	1		1			1		4
12			2						1	3
13	1		1	1					1	4
14		1		2					1	4
15		1	1	1					1	4
16	1	1		1						3
17		1								1
18	1	1								2
19	1	1	1		1					4
20		1		1	1					3
21				1						1
22			1	1						2
23			1	1						2
24										0
25	1							1		2
26			1						1	2
27				1						1

[a] See Table 4. The SMS is the Stores Management Set, and the OFP is the Operational Flight Program, i.e., the computer software.

relative to total occurrence."* Depending upon the specific circumstance, they characterized the BITE as "insufficient ... ambiguous ... erroneous ... [and] inappropriate."* Unfortunately for maintenance personnel, the FIVP was also highly critical of "insufficient or incorrect information in tech orders."* This may be one of the reasons why, as indicated in Table 18, the Rand survey found that airmen seldom make direct use of the technical orders on the job.

THE NATURE OF FLIGHT-LINE MAINTENANCE

Jobs in the bomb/nav specialty can be very complex for several reasons:

- The avionics systems are highly integrated.
- The avionics systems are relatively unreliable.
- Maintenance personnel must rely on indirect indications of faults (provided by the system) that are ambiguous.

A large fraction of bomb/nav jobs (over half in our sample) requires troubleshooting. In many of these jobs, maintenance personnel must know how to use a combination of diagnostic techniques to resolve ambiguities. Proficient fault

*FIVP Final Report: Volume 1. Analysis, pp. 3-4, 3-5.

Table 18

THE USE OF TECHNICAL ORDERS AT THE JOB SITE
(Number of jobs)

	Degree of Use of Technical Orders		
Shop	Memory Only	Moderate Use	Extensive Use
Bomb/Nav	74	14	6
Instrument/ Autopilot	30	6	6
Comm/ECM	33	4	12
Total	137	24	24
% of total	74	13	13

isolation of bomb/nav systems often also requires knowledge of the idiosyncrasies of the avionics package, that is, how the components and the LRUs within them interact in various operating modes.

The instrument/autopilot and comm/ECM specialties are less difficult, partly because the systems they deal with are more reliable. Relatively routine activities occurred on 38 percent of the jobs in instrument/autopilot and on 24 percent of those in comm/ECM, as opposed to 16 percent of the bomb/nav jobs. Troubleshooting is required somewhat less often, and fault isolation usually requires the application of only one technique. There is more stress on

interpretation of video displays in instrument/autopilot; more on audio in comm/ECM. Neither specialty uses the computer as a diagnostic aid. Both, especially comm/ECM, occasionally use special test sets. Systems pertaining to these specialties are less highly integrated than are the bomb/nav systems, although there are some interactions among systems and between comm/ECM systems and bomb/nav systems.

IMPLICATIONS FOR TRAINING*

To overcome the basic shortcomings in the fault isolation capability, given the present state of the art of advanced avionics systems, and because of the idiosyncratic nature of each advanced avionics system, maintenance technicians need a thorough knowledge of the particular avionics system they are going to work on. For example, on the F-111D the ARS feeds data to the DCC and the IDS. Depending on the type of signal, mode of operation, operator action, and timing of output, the fault status indication of a particular LRU may or may not be valid.

The key to effective and efficient maintenance is the ability of the man to use all diagnostic tools to increase

*For a more detailed examination of avionics training, see Polly Carpenter-Huffman and Bernard Rostker, The Relevance of Training for the Maintenance of Advanced Avionics, R-1894-AF, The Rand Corporation, and Richard E. Duren, A Proposed Course for Avionics Technicians, R-2049-AF, The Rand Corporation.

the accuracy of diagnosis and to decrease the time expended on maintenance actions. Choosing the appropriate sequence of actions, including diagnostic R/I, is the most demanding aspect of maintenance, particularly in the bomb/nav specialty. Use of such complex techniques, composed as they are of combinations of logical deduction and pattern recognition, requires both the development of cognitive skill in devising strategies for fault isolation and interpreting the results and also extensive exposure to patterns of occurrence of clues to LRU failure. These processes are particularly suitable for formal training where the controlled environment permits concentration on the development of intellectual capabilities and where a large number and wide variety of failures can be generated.

Review of technical school curricula, however, indicates a lack of specific training in the use and interpretation of diagnostic techniques. This was particularly true under the representative training concept, where specific training was not given in troubleshooting the F-111D/Mark II avionics system.

The lack of specific training on Mark II systems performance is indicated in the job content data. In 138 of 141 job interviews, the Rand team questioned the maintenance personnel about the source of pertinent training. Table 19 shows their responses. Their options included on-the-job training (OJT), field training detachment (FTD) course, Task

Table 19

SOURCE OF PERTINENT TRAINING
(Number of times mentioned)

Shop	Number Interviewed	Training			
		OJT	FTD	TOT	Tech School
Bomb/Nav	67	67	14	5	5
Instrument/ Autopilot	37	37	1	--	7
Comm/ECM	34	34	21	--	3
Total	138	138	36	5	15

Oriented Training Program (TOT, originally MISD), and technical school. On-the-job training includes all experience acquired while a person is assigned to the flight line, whether or not he is under the guidance and direction of an official OJT trainer. Since in comm/ECM, the FTD conducts the second half of a three-level technical school, the distinction between technical school and FTD may not be clear. Nevertheless, technical school was mentioned in only 6 percent of the jobs.

In sum, the job content analysis helped us derive the general skills and knowledge needed for job performance in maintaining advanced avionic systems on the flight line. Almost all of these must be learned because they are not part of the average person's repertoire. For example, the proper

R/I of LRUs should be taught formally because of its key role in troubleshooting and repair and because improper procedures can be seriously destructive. In addition, since nothing but a small subset of what needs to be learned can be derived from fundamental principles, virtually all job performance in these specialties is job specific; it cannot be derived by application of general principles. The performance of tasks that are idiosyncratic to specific systems should be taught either on exact copies of the systems or on adequate facsimiles of them. Whether a facsimile is adequate depends on what is being taught. For example, a mockup might be sufficient for teaching the R/I of LRUs, the aircraft itself might be best for ops checking, and a simulator best for teaching troubleshooting. For integrated avionics, it is particularly important that all systems that interact on the aircraft interact on the simulator, especially for teaching troubleshooting.

The importance of having training content be specific to particular models of F-111 aircraft for the instrument/autopilot and comm/ECM specialties is less obvious. Some knowledge of this type would appear to be useful for comm/ECM (and should not be ruled out for instrument/autopilot), but less depth of understanding of systems integration is required than for bomb/nav.

Appendix

FIELD OBSERVATION SUMMARIES

NOTE: Each Rand ID number corresponds to an interview, which may cover more than one job.

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FIELD OBSERVATION SUMMARY

Rand ID 1 Work Center RR System 64B

349 Data

	1	2	3	4	5
JCN	0910664				
TM	B				
WUC	64 BCD				
AT	Y				
WD	B				
HM	615				
Start:	01 1200				
Stop:	01 1215				
Skill	7				

NARRATIVE OF MAINTENANCE ACTION:

Roadrunner (RR) received the report that the aircraft had lost communications with the right seat. The communications personnel cord was found to be the problem.

This maintenance man (MM) had gained pertinent experience during the period that he had held another AFSC.

The tasks required some limited special knowledge, which had been learned while on the job (OJT).

EXPERT COMMENT:

1st--Job satisfactorily accomplished (JSA).

2nd--MM acted too much on presumption. He should have had pilot plug into center console first to test connector condition.

AIRCRAFT FOLLOWUP:

Discrepancy re 64BCD after this flight--"Right mike cord is bad." No problem in future sorties in April.

Activity Sequence

1 Communication personnel (PE) cord most likely cause of problem; based on experience. Ordered PE cord.

2 Installed temporary PE cord

3 Operated intercom communications set as check

OK

4 End of job (sent to shop for permanent repair)

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FIELD OBSERVATION SUMMARY

Rand ID 2 Work Center RR System 73P

349 Data

	1	2	3	4	5
JCN	NONE				
TM	(349 was later				
WUC	prepared by				
AT	shop personnel)				
WD					
HM					
Start:	01				
Stop:	01				
Skill					

NARRATIVE OF MAINTENANCE ACTION:

The report to the Roadrunner team was of INS excessive drift in flight; also TACAN problems. When the trouble shooting did not lead to a quick solution of the matter, was turned over to a shop crew.

The need for Roadrunner personnel by an aircraft seeking to launch cut this maintenance action short.

Step 3 required use of Preliminary T.O.; also the 2nd spec required T.O. memory. All actions were based on OJT.

EXPERT COMMENT:

This is not a good task sequence. Both experts would have checked IRU following indication of a failed heat exchange. Job details missing.

AIRCRAFT FOLLOWUP:

Aircraft history: No data present regarding this RR action. Many 73P write-ups after sorties this period.

Activity Sequence

1. Roadrunner team: aircraft operating
2. MM asked pilot for ground speed and drift to check tolerances (of INS)

Distance was out of tolerance

3. Addressed computer to check ARS

Heat exchange failing

4. Removed ARS transmitter
5. Call for shop personnel to continue job
6. End of job (for Roadrunner)

FIELD OBSERVATION SUMMARY

Rand ID 3 Work Center RR System 73H

349 Data

	1	2	3	4	5
JCN	0910665				
TM	B				
WUC	73 H00				
AT	L				
WD	B				
HM	127				
Start:	01:1200				
Stop:	01:1215				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Trouble was reported with the IRU just prior to launch. The MM considered the switch position error the cause of the trouble report.

The advice given was drawn from memory. Recycling often resulted in the INS working OK. This maintenance procedure was learned while on the job.

EXPERT COMMENT:

Job was satisfactorily accomplished.

AIRCRAFT FOLLOWUP:

No data this action; no discrepancy this system on next sortie (Take-off at 12:33).

Activity Sequence

1. MM advised pilot to recycle system
2. Pilot discovered switch in wrong position
3. System then operated properly (pilot report)
4. End of job

FIELD OBSERVATION SUMMARY

Rand ID 4 Work Center RR System 73H

349 Data

	1	2	3	4	5
JCN	0910661				
TM	B				
WUC	73 HGO				
AT	R				
WD	B				
HM	242				
Start:	01:1215				
Stop:	01:1450				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This was a Roadrunner action. A problem was reported in all computer modes with the Stores Management System. All program addresses OK but it still reads unsatisfactory.

The preliminary TO was used to obtain the computer address numbers and to evaluate the output. This job was learned through on-the-job training and experience.

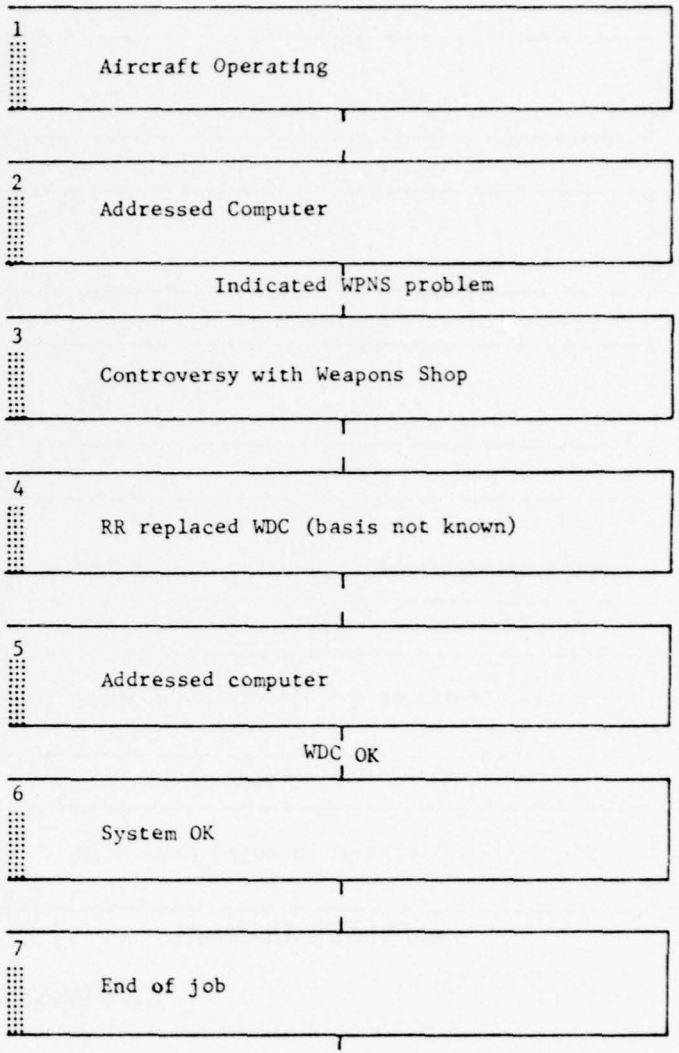
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No data this action. There was a discrepancy report on the 73H system next flight (at 011406).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 5 Work Center RR System 73K

349 Data

	1	2	3	4	5
JCN	0910851				
TM	B				
WUC	73 KF0				
AT	R				
WD	D				
HM	242				
Start:	01:1335				
Stop:	01:1450				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Roadrunner called over to work TFR problem. They did not succeed in solving the problem. Work was done from memory.

Except for task 7, where tech school information was used, all knowledge of procedures and decisions resulted from job experience.

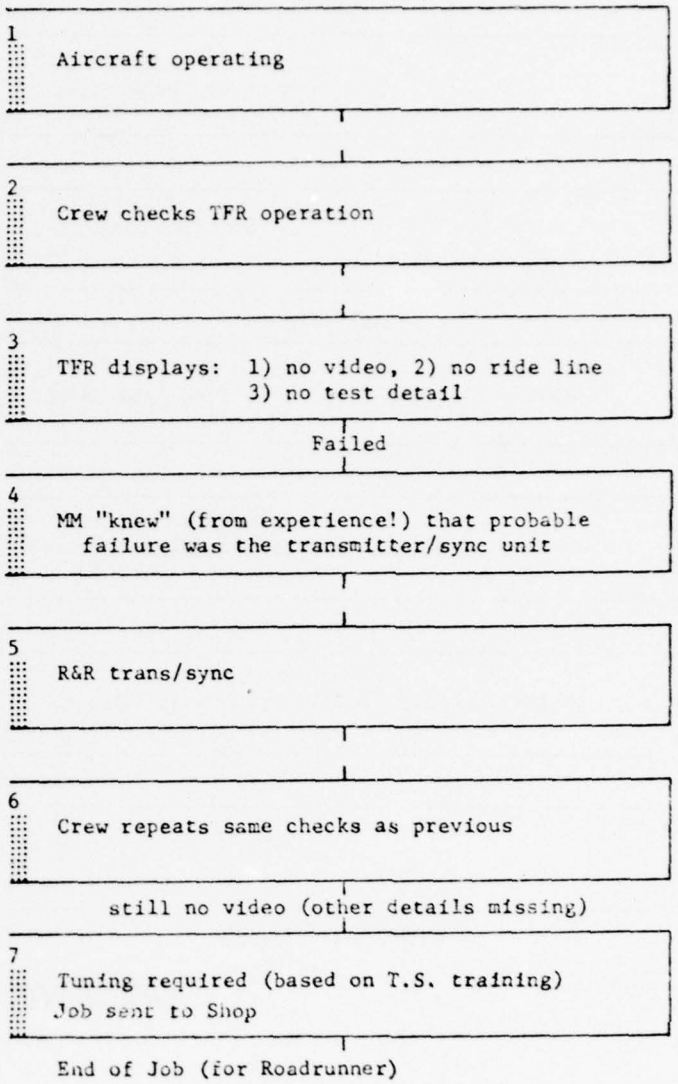
EXPERT COMMENT:

Too much reliance on memory in step 5, the R&R of trans/sync. Description of job needs more detail regarding result of step 6.

AIRCRAFT FOLLOWUP:

In the test station (TS) the action taken was "A" with "how mal" code of 692. No trouble experienced on next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 6 Work Center RR System 52A

349 Data

	1	2	3	4	5
JCN	0910350				
TM	B				
WUC	52 ACA				
AT	R				
WD	D				
HM	242				
Start:	01:1225				
Stop:	01:1325				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report to the Roadrunner was of auto pilot problem; it did not hold reference; drifted to 200 feet off; slams back through altitude. Tasks 1, 2, and 5 drew on Technical School and OJT training. Some T.O. information was used, from memory, in Tasks 3 and 6.

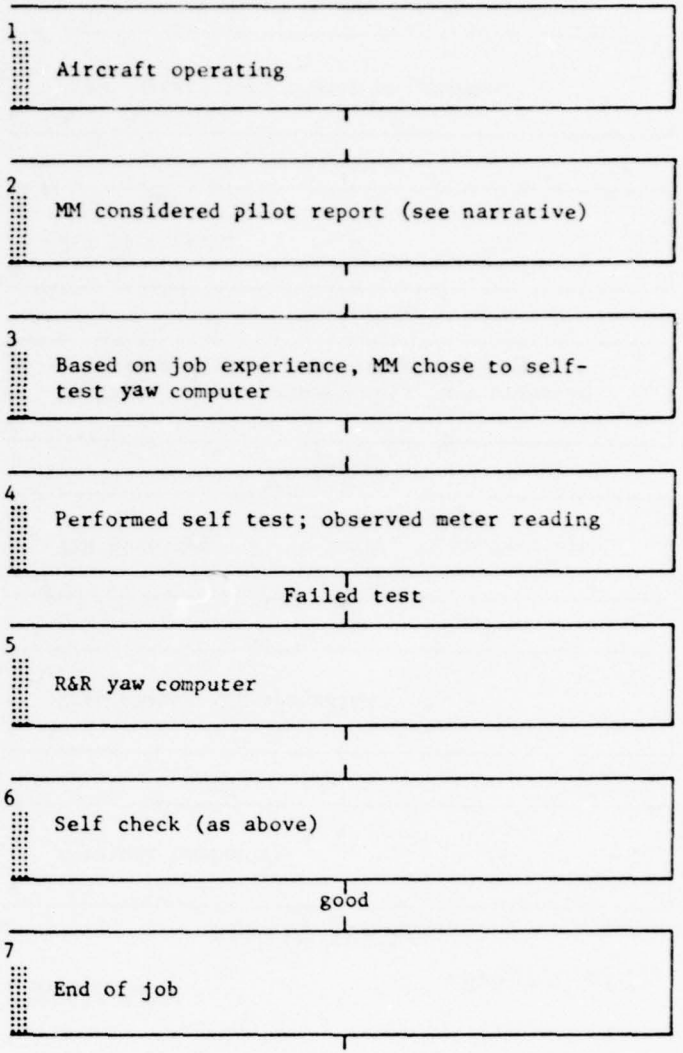
Report was of an auto pilot problem. Using the self-test feature of the yaw computer, the problem was solved.

Steps 3, 4, and 6 drew on Tech School and OJT training. Tech Order information was used, from memory in tasks 4 and 6.

EXPERT COMMENT:

MM should also have performed a pitch computer self-test.

Activity Sequence



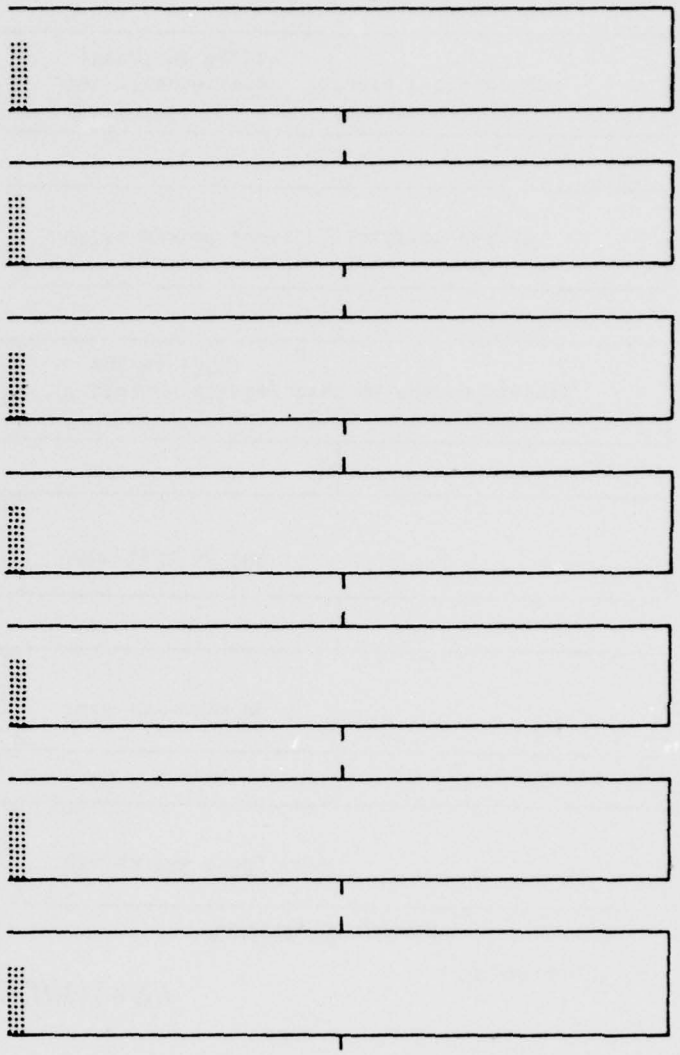
FIELD OBSERVATION SUMMARY

Rand ID 6 Work Center RR System 52A

AIRCRAFT FOLLOWUP:

Record shows aircraft in air during part of this action (until 13:15)! JCN is listed, but no 349 action is recorded! No problem with this system next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 8 Work Center C Shop System 76D

349 Data

	1	2	3	4	5
JCN	0900724	0900724			
TM	B	B			
WUC	76D00	76DD0			
AT	Y	P			
WD	D	D			
HM	692	692			
Start:	01:1345	01:1500			
Stop:	01:1500	01:1530			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

Problem consisted of no G strobe on APS-109.

The Tech. Order was followed in detail. Tasks 3, 4, and 5 were partially learned in FTD; others from OJT.

EXPERT'S COMMENTS:

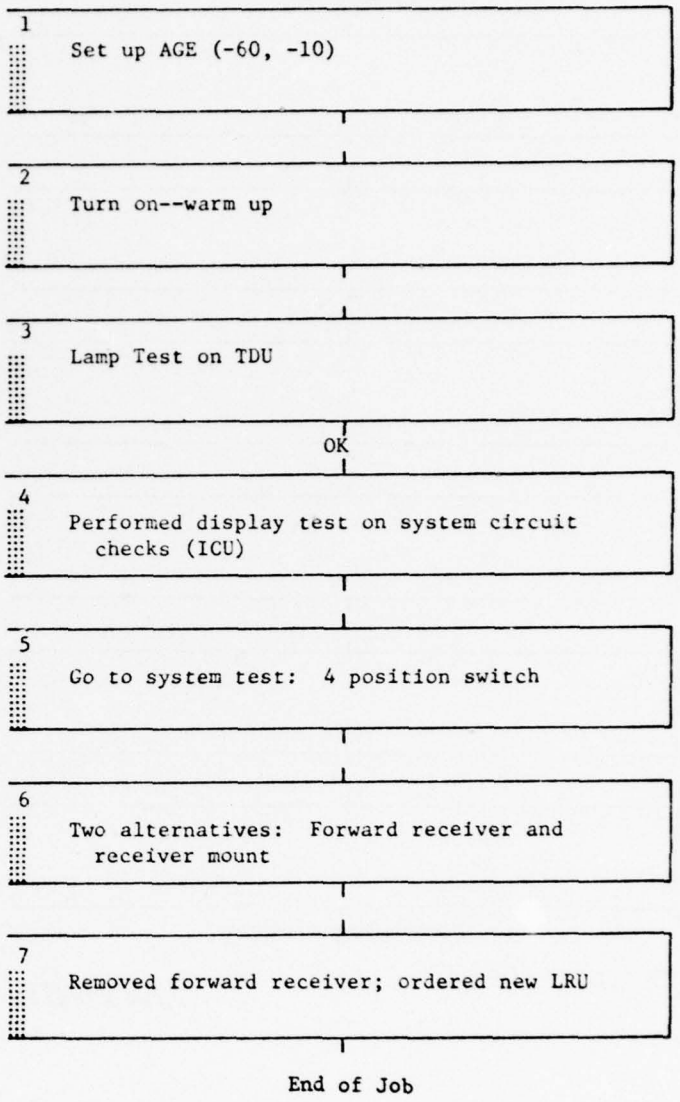
First--JSA.

Second expert--This reviewer felt that more alternatives were feasible (see step 6). They include ICU, ALR-41, the forward receiver, the mount, or the wiring. ALR-41 most likely--only way to check is to switch units.

AIRCRAFT FOLLOWUP:

Test station repaired the unit removed. The unit which was installed worked OK through the next two sorties when it was again removed.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 9 Work Center C Shop System 64B

349 Data

	1	2	3	4	5
JCN	0900709				
TM	B				
WUC	64 BCD				
AT	L				
WD	D				
HM	127				
Start:	01 1300				
Stop:	01 1345				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

A simple requirement to adjust an interphone cord to allow more slack.

Memory of T.O. was useful in ops check.

Task 2 drew on both FTD and OJT.

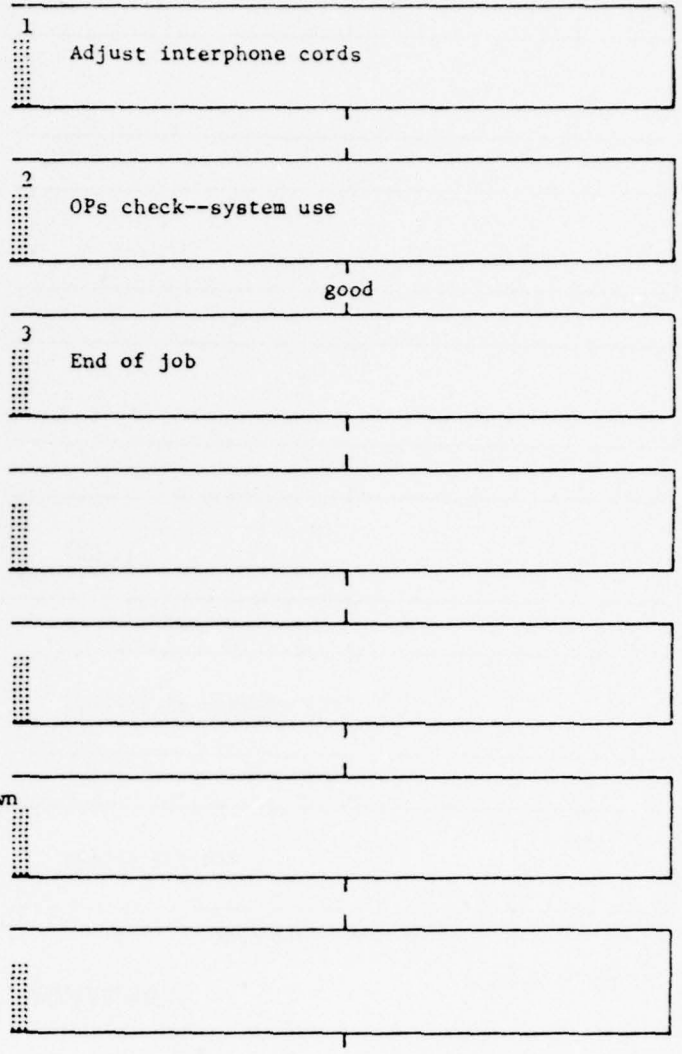
EXPERT COMMENT:

Both JSA.

AIRCRAFT FOLLOWUP:

No 64B problem next flight (4/2). Aircraft may not have flown until 4/4.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 10 Work Center C Shop System 61A

349 Data

	1	2	3	4	5
JCN	0850662				
TM	B				
WUC	61 ACO				
AT	Q				
WD	F				
HM	799				
Start:	01 1700				
Stop:	01 1730				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

MM was required to install an HF control box.

Tech. School had provided useful instruction regarding T.O. use (a T.O. was not actually read and followed during these tasks but it was believed to have been followed (by memory)). Most of the procedure was obvious without previous instruction.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No 61A discrepancy next flight.

Activity Sequence

1 Remove ballast

2 Install HF control box

3 END

FIELD OBSERVATION SUMMARY

Rand ID 11 Work Center C Shop System 65A

349 Data

	1	2	3	4	5
JCN	910752				
TM	B				
WUC	65 AAO				
AT	R				
WD	D				
HM	290				
Start:	01 1600				
Stop:	01 1800				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

A/G IFF inoperative on alberque center.

Memory of T.O. was sufficient to perform tasks.

All tasks drew on OJT. Tasks 1,2,3 and 6 (a repeat of 2) drew on FTD training. Tech. school acquainted airmen with T.O.s.

EXPERT COMMENT:

1st--MM probably also did the following:
1. opened panel and checked lights on R/T after step 3.
2. observed no lights on at step 7.

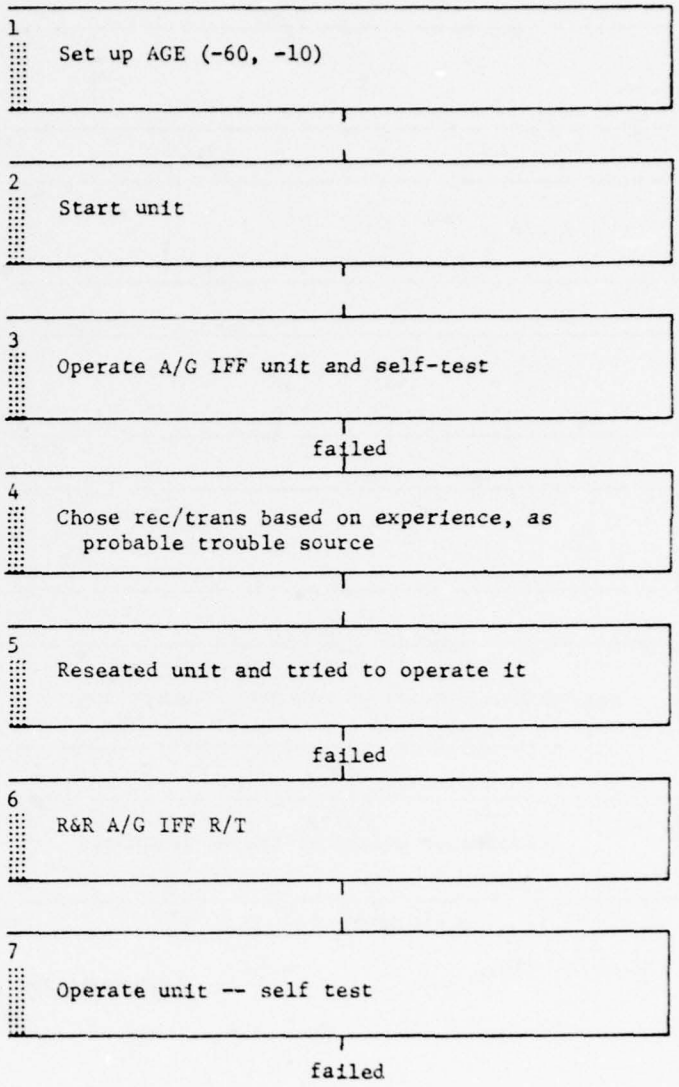
To judge actions further, one needs assurance that other checks were not made after step 1, i.e., contacting departure via UHF, and need to know what lights were out after step 5.

2nd: MM should have used test set after step 5 to check R/T and C/B. (P4)

AIRCRAFT FOLLOWUP:

No repeat next sortie.

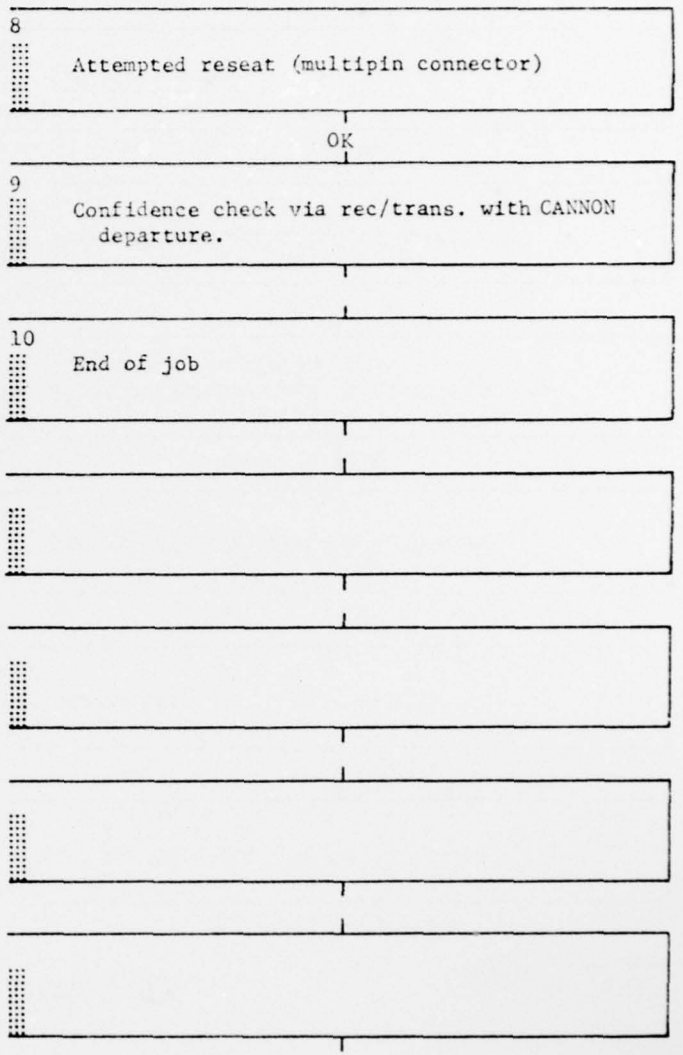
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 11 Work Center C Shop System 65A

Activity Sequence



FIELD OBSERVATION SUMMARY

Bond ID 12 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0900731				
TM	B				
WUC	14 HAG				
AT	Q				
WD	D				
HM	799				
Start	01:1805				
Stop	01:1850				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The take-off trim light was missing. Replacement is quite simple. Tech. Order knowledge is required to insure trim light comes on at the proper time.

Job was entirely learned OJT.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

Next flight on 4/2 did not report 14H trouble.

Activity Sequence

1. Hooked up -60 AGE
2. Installed TOT light
3. Visually checked light operation
   OK
4. Operated trim controls to see that light came on at proper setting
   OK
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 13 Work Center A Shop System 734

349 Data

	1	2	3	4	5
JCN	900751				
TM	B				
WUC	73HPO				
AT	P				
WD	D				
HM	242				
Start:	01:1630				
Stop:	01:1730				
Skill	3,5				

NARRATIVE OF MAINTENANCE ACTION:

Problem with the dual bomb timer (DBT); no pullup occurred on count down. Corrective action was to pull the converter set. No replacement immediately available.

MM stated that he did not use T.O. except for some numerical codes and that all tasks were learned via OJT.

EXPERT COMMENT:

The PCD error tags should have indicated if WDC or C/S had malfunctioned, whereas this interview suggests its removal was based only on a general knowledge that the C/S affected WDC operation.

MM should have left DBT write-up open.

AIRCRAFT FOLLOWUP:

This JCN was generated by a noon flight on 3/31. The record of this JCN shows several TS actions on 73HPO prior to this removal action, but none after the removal. An installation by A Shop was made about 5 hours after the removal.

There was no 73H discrepancy next flight.

Activity Sequence

1. Hooked up AGE (-60, -10)
2. Turn on systems incl. computers
3. Entered via NDEP data to allow bombrun simulation

Fail--no pullup on count down (visual)

4. Checked Avionics Test Panel

WDC not up

5. Read PCO error trap

C/S bad

6. Pulled C/S (usually affects WDC)
7. End of job

FIELD OBSERVATION SUMMARY

Rand ID 14 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0900750				
TM	B				
WUC	73RA0				
AT	P				
WD	D				
HM	242				
Start:	01 1730				
Stop:	01 1830				
Skill	5, 3				

NARRATIVE OF MAINTENANCE ACTION:

Pilot had reported an in-flight failure of the left HUD (heads-up display). MM stated that, although he could not duplicate the failure on the ground, he "guessed" that it was defective, and removed it.

No Tech. Order was used and all tasks related knowledge was obtained via OJT.

EXPERT COMMENT:

First--HUD should not have been replaced unless failure was detected or a recurring flight malfunction.

Second expert--Need a better discrepancy write-up.

AIRCRAFT FOLLOWUP:

TS bench-checked serviceable--no defect. A Shop installed a unit on 4/2. Sortie on 4/4 resulted in a discrepancy report re the right HUD. Sortie following on 4/8 reported problems in both HUDs.

Activity Sequence

1 Aircraft power already on

2 MM operated HUD on ground but could not duplicate in-flight failure

3 MM assumed that left HUD was actually defective and removed it.

3 Installed ballast in place of HUD

4 End of job

FIELD OBSERVATION SUMMARY

Rand ID 15 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	090753	090753			
TM	B	B			
WUC	73 PDO	73 POO			
AT	R	X			
WD	D	D			
HM	242	242			
Start:	011830	011905			
Stop:	011905	011915			
Skill	3,5	3,5			

NARRATIVE OF MAINTENANCE ACTION:

Aircraft already being worked on. This action addresses a problem with radar transmitter--could not get any sweeps; ARS fails in flight.

No Tech orders were followed directly. All training was during OJT.

EXPERT COMMENT:

One felt that the first MM should have determined in what modes the radar was not sweeping (test or transmit). Write-up should give result of XTMR R&R.

The second expert reviewed felt that the MM should first have checked ATP and also addressed computer. Perhaps trouble was in MFG. Poor description of job but also seems to be poor maintenance procedure.

AIRCRAFT FOLLOWUP:

At the same time that action #2 above was underway A Shop reported that following a quality control check (a special inspection) the 73PDO unit tested "no defect." A few hours later

Activity Sequence

1 AGE already operating

2 Considered failure possibilities; experience indicated either EPU or transmitter failure

3 MM decided, based on OJT, to replace transmitter first--R&R XTMR

4 Address computer

EPU failure

5 Removed EPU

6 End of job

7 MM said replacement was left til later--job code says R&R completed.

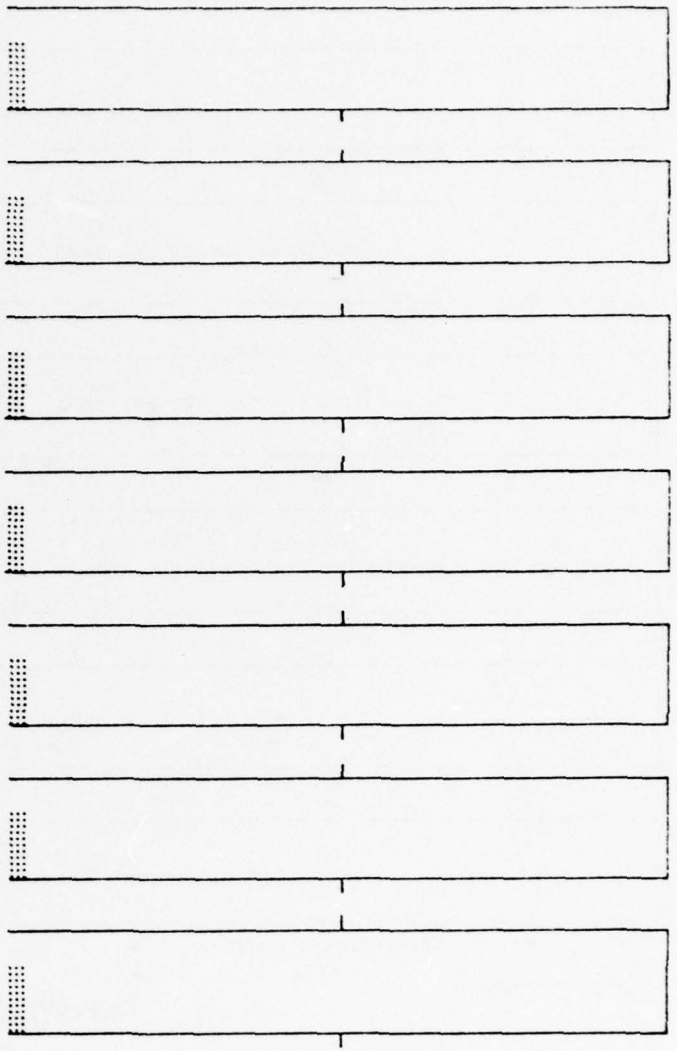
FIELD OBSERVATION SUMMARY

Rand ID 15 Work Center A Shop System 73P

the test station reported a bench check-repaired action--presumably on the removed equipment (item #1).

The next flight on 4/8 resulted in a 73P discrepancy report.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 16 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0910709				
TM	B				
WUC	73RCO				
AT	L				
WD	D				
HM	127				
Start:	01:1800				
Stop:	01:2000				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report was that the right designator cursor unit moved erratically. MM could not duplicate this problem. To avoid calling a 7 level over to the job (to endorse a Can Not Duplicate--CND) he wrote it up as a reseating of the STU.

No T.O. was used. OJT was basis for knowledge.

EXPERT COMMENT:

Both experts regarded step 4 as totally unnecessary and unrelated.

AIRCRAFT FOLLOWUP:

No TS action required; no problems this system on next flight.

Activity Sequence

1 ACE already hooked up

2 Turned on system

3 Operated right designator cursor and observed visually

OK

4 Reseated the STU

5 Operated cursor as above

OK

6 End of job

FIELD OBSERVATION SUMMARY

Rand ID 17 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0910706				
TM	B				
WUC	73HGO				
AT	R				
WD	D				
HM	242				
Start:	01:1600				
Stop:	01:1800				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The converter set was suspect as the WDC would not come up.

The job involved repeated use of computer codes to identify the failed unit. Final conclusion was a bad WDC; system OK after WDC replacement.

The Preliminary Tech Order with computer check codes was extensively used. Their use had been learned through OJT.

EXPERT COMMENT:

Was job satisfactorily accomplished? Yes.

AIRCRAFT FOLLOWUP:

No TS actions; no discrepancy report this system next sortie.

Activity Sequence

1 Set up AGE (-60, -10)

2 Power-up DCC

3 Addressed computer to check C/S

WDC down

4 Checked PCO trap in GNC

Indicated C/S failed

5 R&R with good converter set

Still same test result

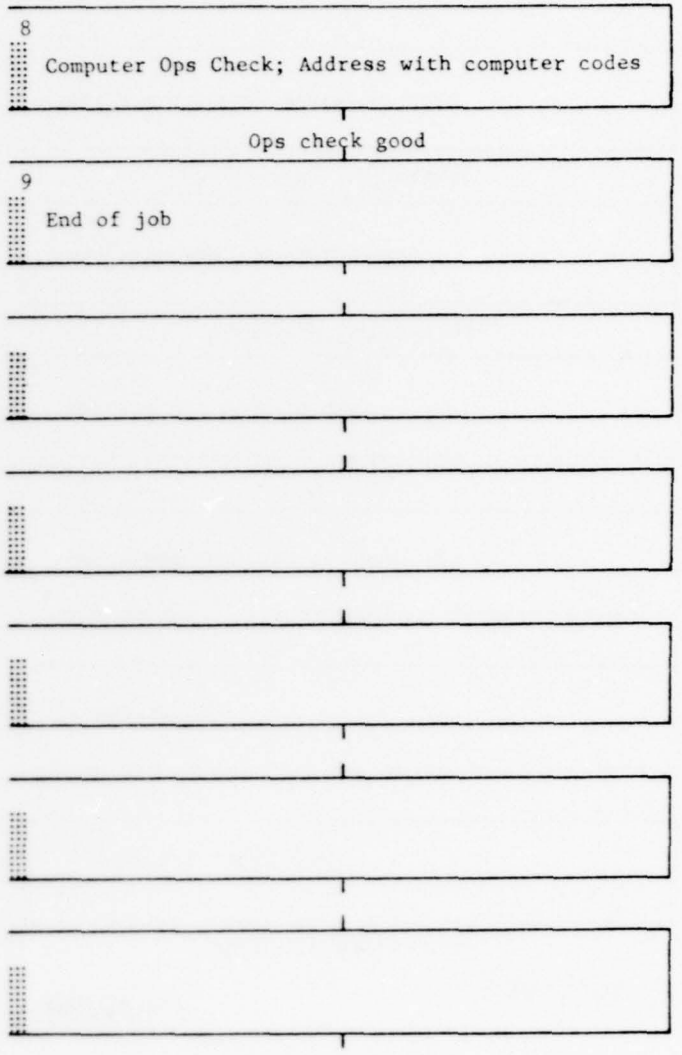
6 Replaced original converter set

7 R&R WDC

FIELD OBSERVATION SUMMARY

Rand ID 17 Work Center A Shop System 73H

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 18 Work Center A Shop System 73C

349 Data

	1	2	3	4	5
JCN	090H052				
TM	P				
WUC	73CAP				
AT	S				
WD	M				
HM	800				
Start:	01:2000				
Stop:	01:2130				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The 349 forms prepared at the time of job completion indicated as the discrepancy "install low-altitude radar altimeter indicator." The unscheduled maintenance code "B" and action taken code "Q" (installation) were entered, with the discrepancy discovered after flight. Apparently upon review this record was changed as BLIS data showed a removal and reinstallation (S) to facilitate other maintenance (800) as part of a phased inspection (M). (Aircraft number, JCN, and start and stop times checked OK.)

The maintenance man did not use a T.O. He regarded the job as simple and had learned the procedures via OJT.

EXPERT COMMENT:

Not a lot to comment upon but the time seemed excessive--30 minutes proposed as more reasonable.

AIRCRAFT FOLLOWUP:

No data this aircraft after sortie on 3/27.

Activity Sequence

1 Installed LARA Indicator

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 19 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0860726	0860726			
TM	B	B			
WUC	73R00	73RE0			
AT	X	R			
WD	D	D			
HM	242	242			
Start:	02:0800	02:0900			
Stop:	02:0900	02:1100			
Skill	5, 3	5,3			

NARRATIVE OF MAINTENANCE ACTION:

The discrepancy write-up indicated that following an R&R of an MSD that no TFR display could be obtained on the MSD and that the system should be ops checked.

The maintenance man relied on his experience in choosing the units to R&R. He concluded that either the MSD, VSD, or STU could be causing the TFR problem. But he was uncertain after replacing both the VSD and STU as to what to do next (since the MSD had just previously been R&R'd).

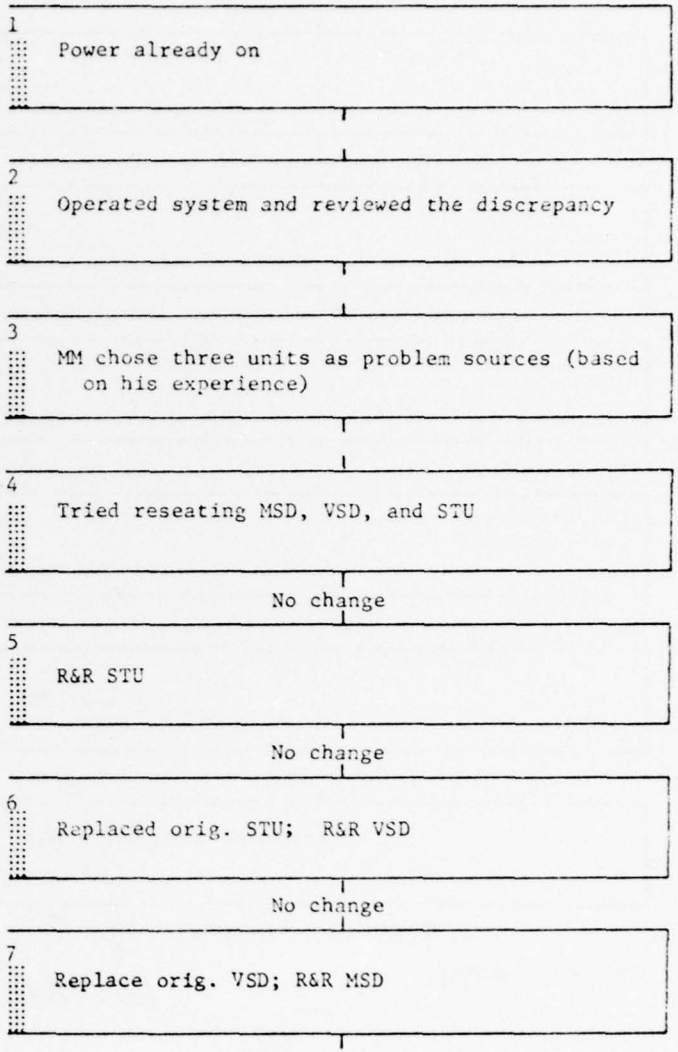
He discussed this problem with the tech rep who endorsed his suggestion that he remove and replace the MSD again. This did result in good TFR operations.

No T.O.s were referred to during this work and all training was OJT.

EXPERT COMMENT:

First expert--Very poor job; the MM's guess included all possible LRUs. He should have eliminated the VSD and STU because of the problem nature, i.e., "no TFR display on MSD." The MM should have checked the VSD display; if the ARS is up on

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 19 Work Center A Shop System 73R

NARRATIVE OF MAINTENANCE ACTION: (continued)

EXPERT COMMENT:

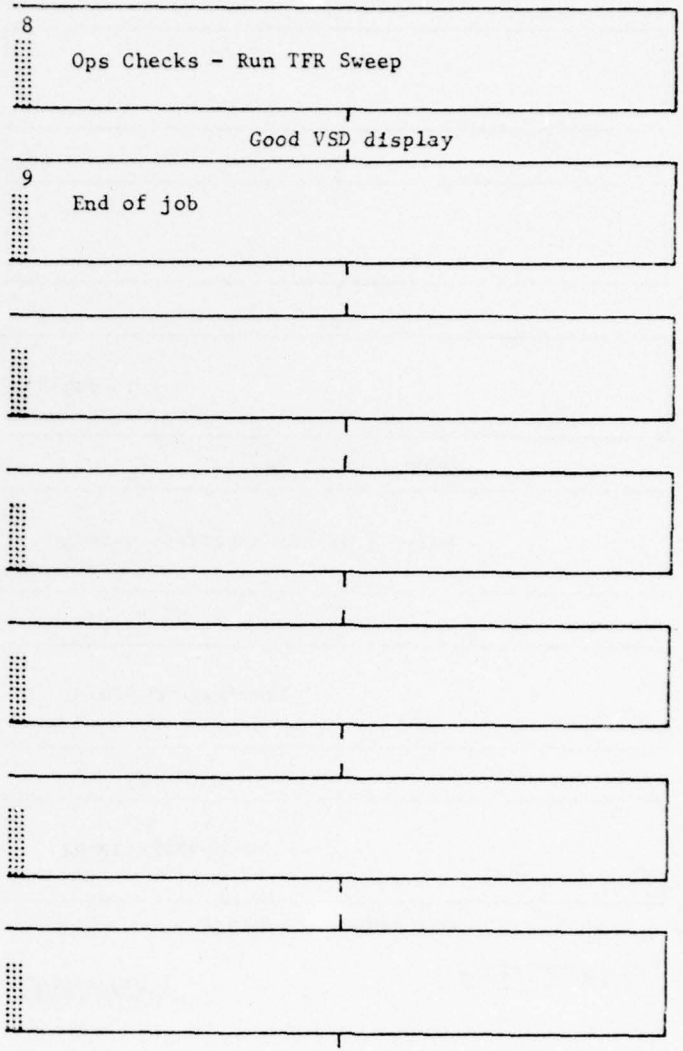
the MSD, a good STU is indicated. Only the MSD should have been pulled. He should not have assumed a just previously included MSD was good.

While generally understandable, the second expert would have pulled the MSD sooner.

AIRCRAFT FOLLOWUP:

TS bench checked and repaired 73 REO. Next flight (4/4) reported no problem in 73R systems.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 20 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0860742				
TM	B				
WUC	73K00				
AT	H				
WD	D				
HM	799				
Start:	020900				
Stop:	020945				
Skill	3,5				

NARRATIVE OF MAINTENANCE ACTION:

Both TFR channels reported fail in-flight and on ground; constant fail lites, MM could not duplicate (CND).

Procedures were taken from memory. Both FTD and OJT experiences helped the MM perform this maintenance action.

EXPERT COMMENT:

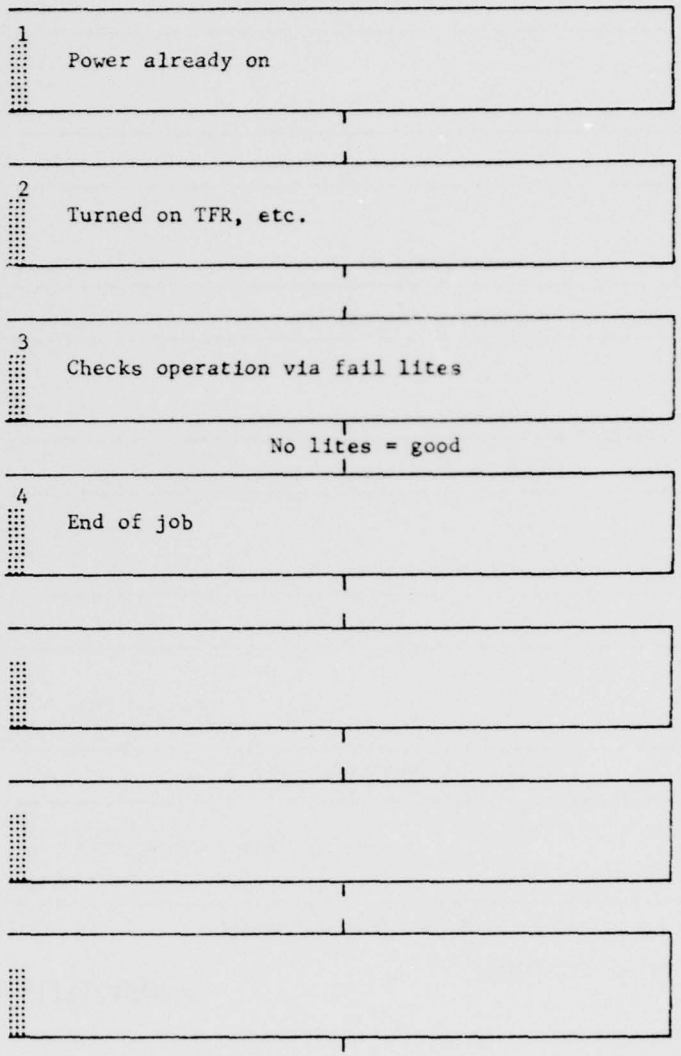
Should have retuned TFR to avoid CND. A second reviewer felt that the MM should have checked the system more thoroughly.

AIRCRAFT FOLLOWUP:

This discrepancy resulted from a flight on 3/27. It was not reported on the later flight the same day. The 349 action did not take place until after this second flight, i.e., on 4/2.

The next flight on 4/3 reported a 73K system problem.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 21 Work Center C Shop System 61B

349 Data

	1	2	3	4	5
JCN	0910767				
TM	B				
WUC	61 BCO				
AT	R				
WD	D				
HM	290				
Start:	02:1230				
Stop:	02:1400				
Skill	5,3,5				

NARRATIVE OF MAINTENANCE ACTION:

Maintenance instructed to remove and replace the HF capacitor. This was done.

Procedures were used from memory.

Pertinent knowledge was acquired entirely through OJT.

EXPERTS COMMENTS

Both JSA

AIRCRAFT FOLLOWUP:

TS bench checked and repaired LRU. No problem this system on next flight.

Activity Sequence

1. Call for B-4 Stand
2. R&R high frequency capacitor
3. End of job (inflight ops check)

FIELD OBSERVATION SUMMARY

Rand ID 22 Work Center A Shop System 73P & 73S

349 Data

	1	2	3	4	5
JCN	0860731	0860732	0860731	0860731	0920661
TM	B	B	B	B	B
WUC	73 PDO	73 PBO	73 PDO	73 PMO	73 SGO
AT	R	R	R	R	P
WD	D	D	D	D	F
HM	242	242	242	242	242
Start:	020935	020730	021040	021150	021350
Stop:	021035	020930	021145	021230	021650
Skill	5	5	5	5	5

NARRATIVE OF MAINTENANCE ACTION:

The attack radar failed completely two hours after takeoff, but came back up after landing. MM relied heavily upon the system test capability provided via computer addressing and ATP readouts. These addresses and other procedures were from the tech. order but were performed from memory.

All pertinent learning was from OJT.

EXPERT COMMENT:

1. Should have fixed MCU first for use in troubleshooting. A common computer readout indicates both transmitter and EPU; MCU would have indicated which LRU.

2. Should change MCU sooner; also change MFG before 2nd R&R of ARST. Should not R&R EPU without checking result of ARST R&R.

AIRCRAFT FOLLOWUP:

Jobs 1 & 3: Test station action was to bench check & repair.

Activity Sequence

1. Hook up AGE: -60, -10

2. Turned on ARS - self test re ATP

Failed

3. Checked the MCU tape

Not working; wrote this up

4. Addressed computer

Indicated failed ARST, EPU, or MFG

5. R&R ARS transmitter

6. R&R EPU

7. Addressed computer

Indicated bad trans

AD-A047 708 RAND CORP SANTA MONICA CALIF F/G 9/5
ANALYSIS OF THE CONTENT OF ADVANCED AVIONICS MAINTENANCE JOBS.(U)
DEC 76 P CARPENTER-HUFFMAN, J NEUFER F49620-77-C-0023
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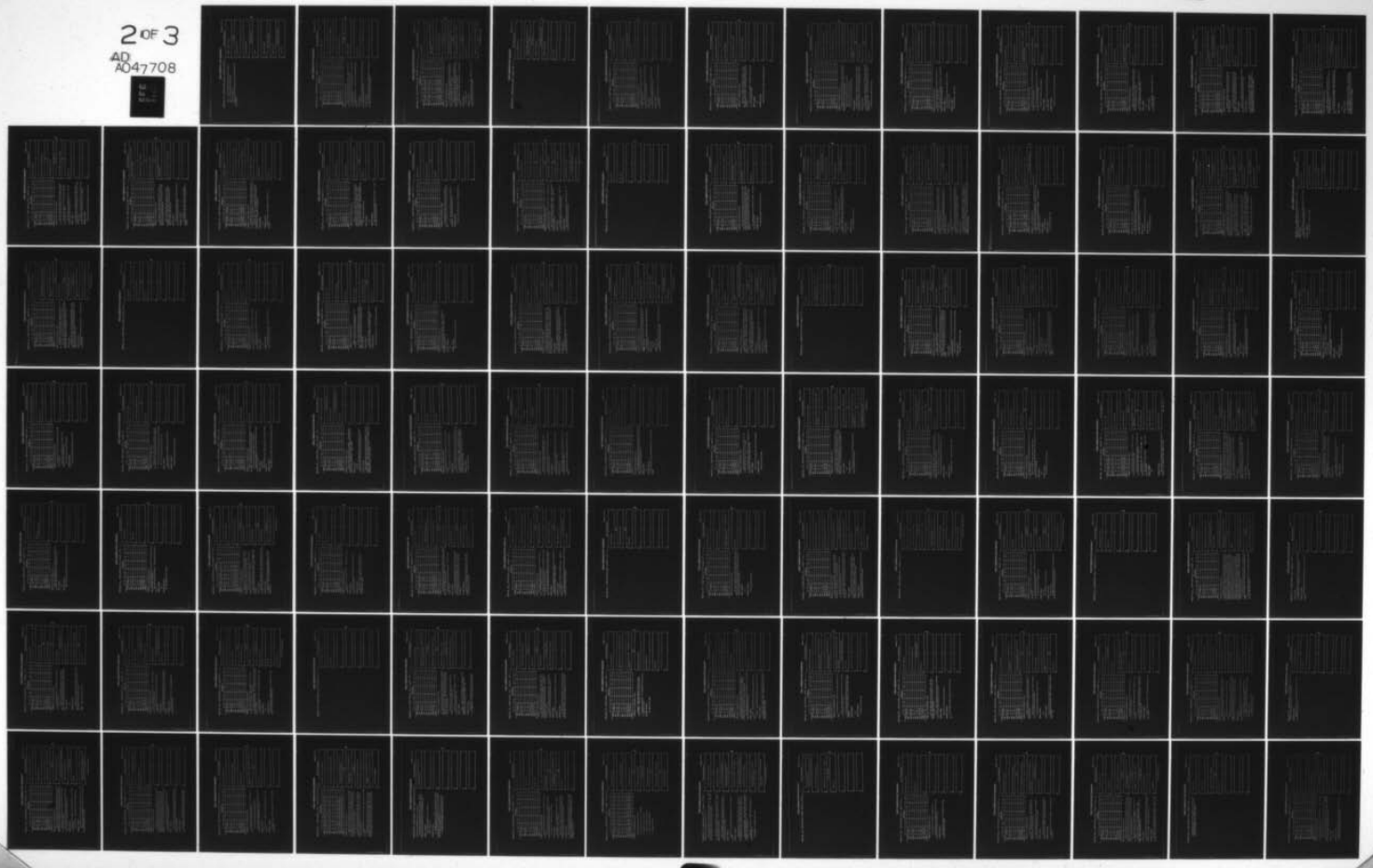


FIELD OBSERVATION SUMMARY

Rand ID 22 Work Center A Shop System 73P & 73S

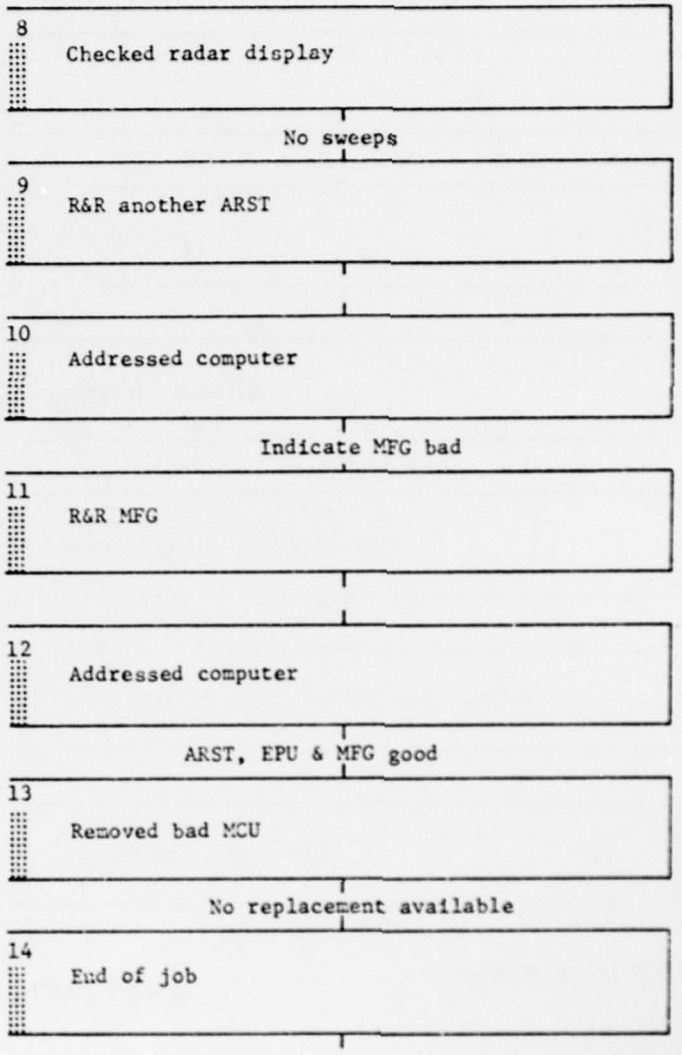
Job 2: TS bench checked serviceable with no defect.

Job 4: TS bench-checked and repaired.

(No data on Job 5)

On 4/3, aircraft 8176's next two sorties reported 73P discrepancies.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 24 Work Center A Shop System 73A

349 Data

	1	2	3	4	5
JCN	0790775				
TM	B				
WUC	73 QB0				
AT	L				
WD	D				
HM	127				
Start:	02 0900				
Stop:	02 1005				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Doppler checked bad in flight tests. After tests MM re-seated some units (thus avoiding a CND writeup).

Procedures were drawn from memory except for computer inquiry codes from T.O.

Training was via OJT. (Tech. school training emphasized FB111As).

EXPERT COMMENT:

MM should also have monitored drift angle and ground speed from computers during self-test.

AIRCRAFT FOLLOWUP:

No 349 data associated with this discrepancy in BLIS data. Next sortie did not report 73Q discrepancy.

Activity Sequence

1 Set up AGE (-60, -10)

2 Turn on DCC, CADC, gyros, and doppler.

3 Select doppler on ATP; test

No lights = OK

4 Address computer

5 End of job

FIELD OBSERVATION SUMMARY

Rand ID 25 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0911000	0900771	0900771		
TM	B	B	B		
WUC	73K00	73KE0	73KK0		
AT	X	G	P		
WD	F	D	D		
HM	799	472	290		
Start:	021045	021230	021315		
Stop:	021100	021315	021430		
Skill	5	5	5		

NARRATIVE OF MAINTENANCE ACTION:

The requirement was to ops check the TFR audio after a TCTO. Also, the right TF channel had a fail light and the left TF channel flagged the TFR computer.

Checking found a good TFR audio, a new fuse fixed the right channel problem, and the left channel trouble was traced to the computer by interchanging computers.

The procedures were drawn from memory. All learning was from OJT.

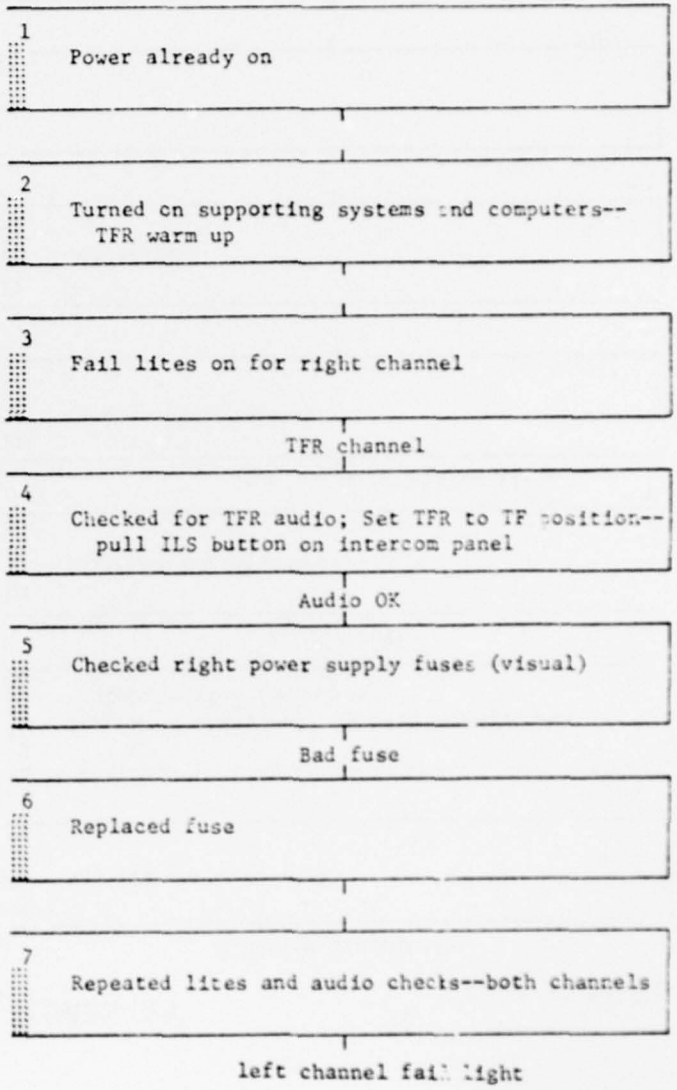
EXPERT COMMENT:

Both stated JSA.

AIRCRAFT FOLLOWUP:

No data this action; first flight listed was on 4/18; no report this system after that sortie.

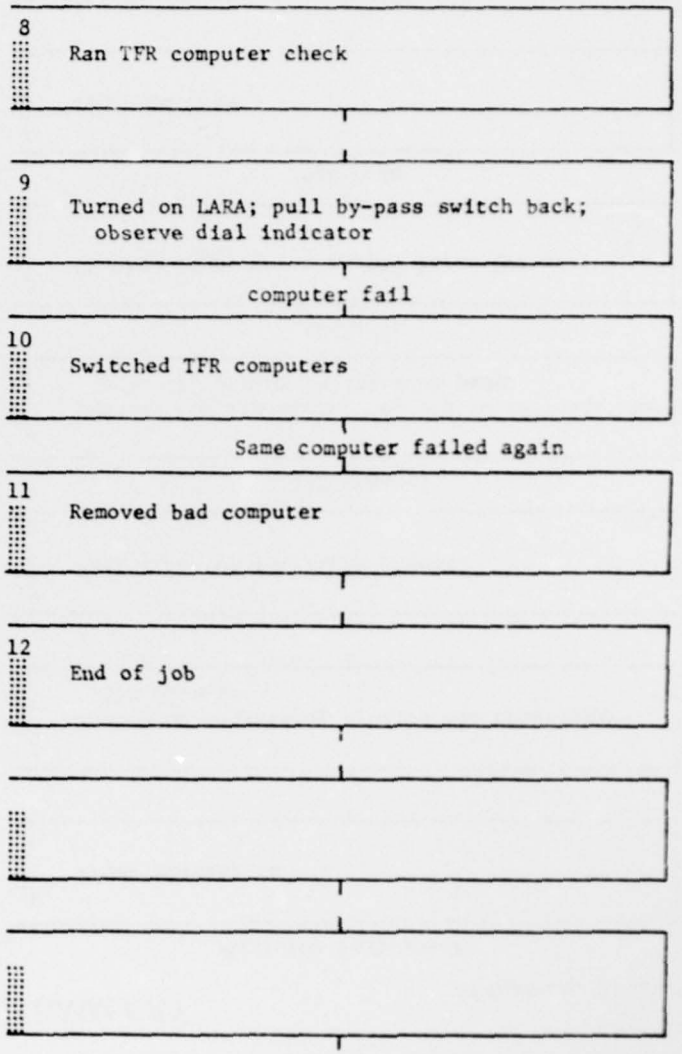
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 25 Work Center A Shop System 73K

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 26 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	900769				
TM	B				
WUC	73R00				
AT	H				
WD	D				
HM	799				
Start:	02:1100				
Stop:	02:1230				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

A report of intermittent operation of the left HUD. The system checked OK.

The self-test was performed by memory of the procedure which had been learned through OJT.

EXPERT COMMENT:

One said JSA, the other felt that the HUD self-test should have been repeated several times.

AIRCRAFT FOLLOWUP:

Next sortie of 8162 was on 4/18. No 73R discrepancies were reported.

Activity Sequence

1 All systems already on

2 Select HUD Self-test (ATP)

No lites--System OK

3 End of job - CND

FIELD OBSERVATION SUMMARY

Rand ID 27 Work Center B Shop System 23Y

349 Data

	1	2	3	4	5
JCN	0280254				
TM	B				
WUC	23 YAB				
AT	U				
WD	F				
HM	799				
Start:	02:1640				
Stop:	02:1735				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Required to install a Tachometer Indicator. This was done. A Tech. Order was followed closely in task 2. The installation, task 3, was performed by memory of the procedure.

Task 2 had been learned in Technical School and OJT. Task 3 was learned via OJT.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

Aircraft 8124 was not listed in discrepancy report.

Activity Sequence

1 Obtained a Tachometer Indicator

2 Put on range markings

3 Installed indicator in aircraft

4 End of job (Ops check later)

FIELD OBSERVATION SUMMARY

Rand ID 23 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0860775				
TM	B				
WUC	73HCO				
AT	L				
WD	D				
HM	127				
Start:	02:1235				
Stop:	02:1335				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report stated that INS had dumped 3 miles after take-off. Data entered in box 3 included magnetic variation, wind speed and direction, and target coordinates.

Maintenance concluded the action as a CND.

Memory was used for all procedures.

OJT was source of procedural knowledge.

EXPERT COMMENT:

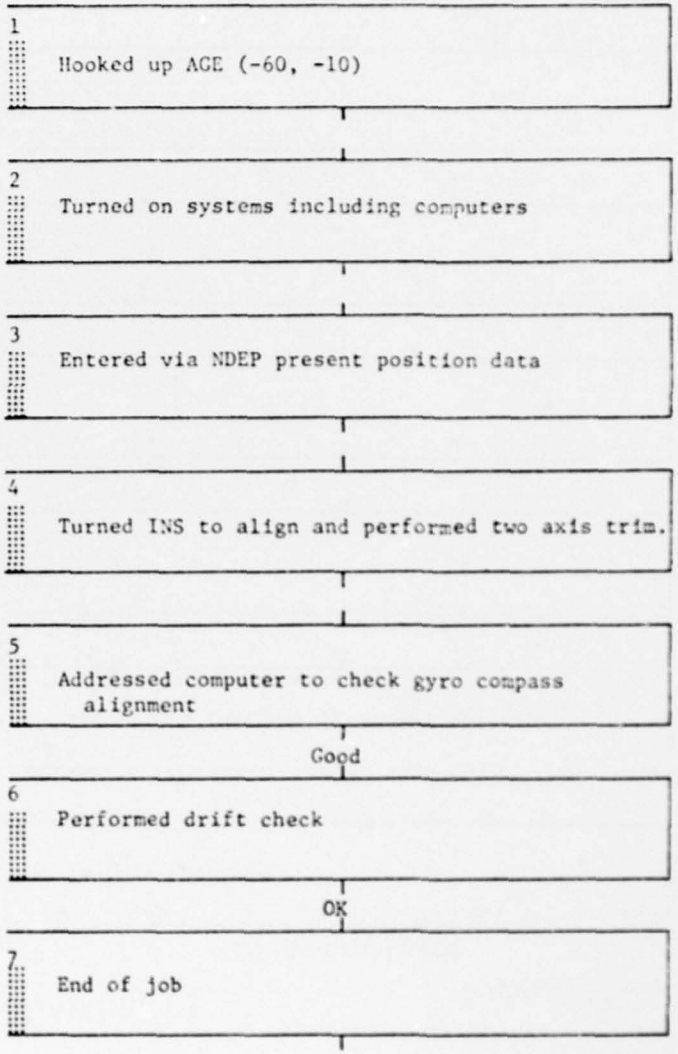
Experts differed on appropriate order for gyro compass align and 2-axis trim. Two had differing opinions and third said alignment prior to 2-axis trim "was a possible sequence."

AIRCRAFT FOLLOWUP:

No 349 action was listed for this JCN in Debrief/AFTO 349 Reconciliation Report. There appears to have been a recording error as to JCN number which prevented the 349 action from being listed.

No problems this system next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 28 Work Center C Shop System 76K

349 Data

	1	2	3	4	5
JCN	0860718				
TM	B				
WUC	76KKO				
AT	Q				
WD	D				
HM	799				
Start:	02:1800				
Stop:	02:1840				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Maintenance man was required to install an ALQ 94 Low Band Receiver. This was done.

The installation was performed by memory of the procedure which had been learned through OJT.

EXPERT'S COMMENTS:

First--Probably also involved removal of ballast.

Second expert--JSA.

AIRCRAFT FOLLOWUP:

No 76K problems on next flight.

Activity Sequence

1 Install receiver

2 End of job (due for in-flight ops check)

FIELD OBSERVATION SUMMARY

Rand ID 29 Work Center C Shop System 63A

349 Data

	1	2	3	4	5
JCN	0910716				
TM	B				
WUC	63 AAO				
AT	Q				
WD	D				
HM	799				
Start:	02:1750				
Stop:	02:1930				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

An installation and ops check of a UHF rec/trans. was required. It was completed.

The T.O. covering this installation was available, but the work was done via memory.

FTD and OJT instruction proved useful.

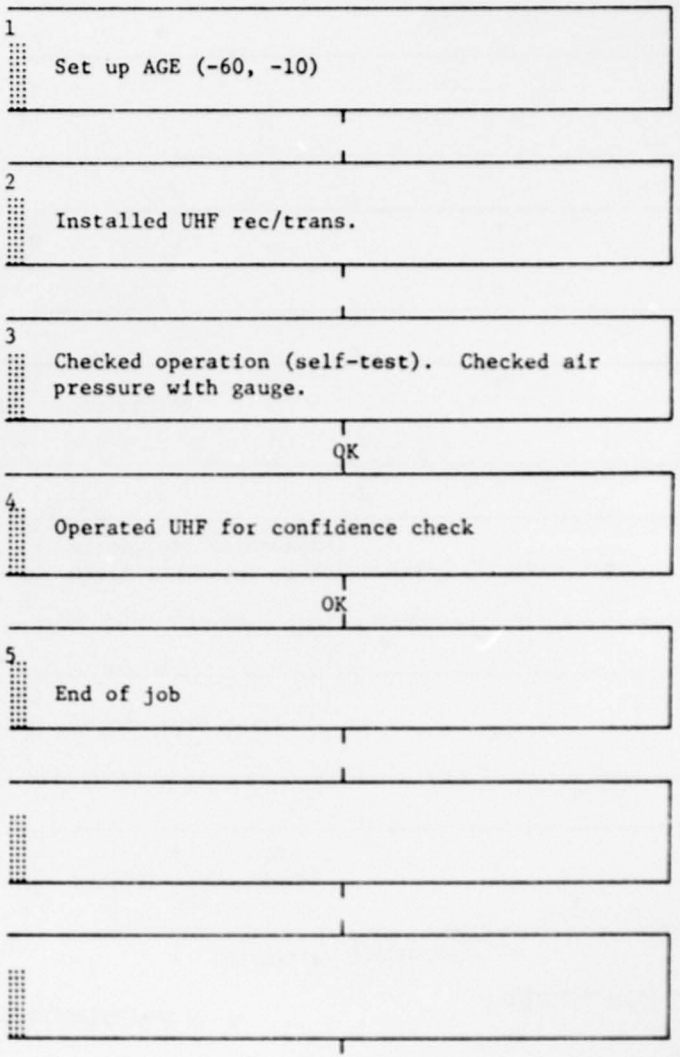
EXPERTS COMMENTS:

First, JSA. Second; should have used ARM-113 test set after step 3.

AIRCRAFT FOLLOWUP:

No repeat on next sortie of this discrepancy.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 30 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0900678				
TM	B				
WUC	14 HAA				
AT	Q				
WD	F				
HM	799				
Start:	02:1840				
Stop:	02:1905				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Right stick, previously removed to facilitate other maintenance (FOM), was to be reinstalled. This was done and then exercised in an ops check.

The procedures of the three tasks were drawn from memory. All tasks were learned via OJT.

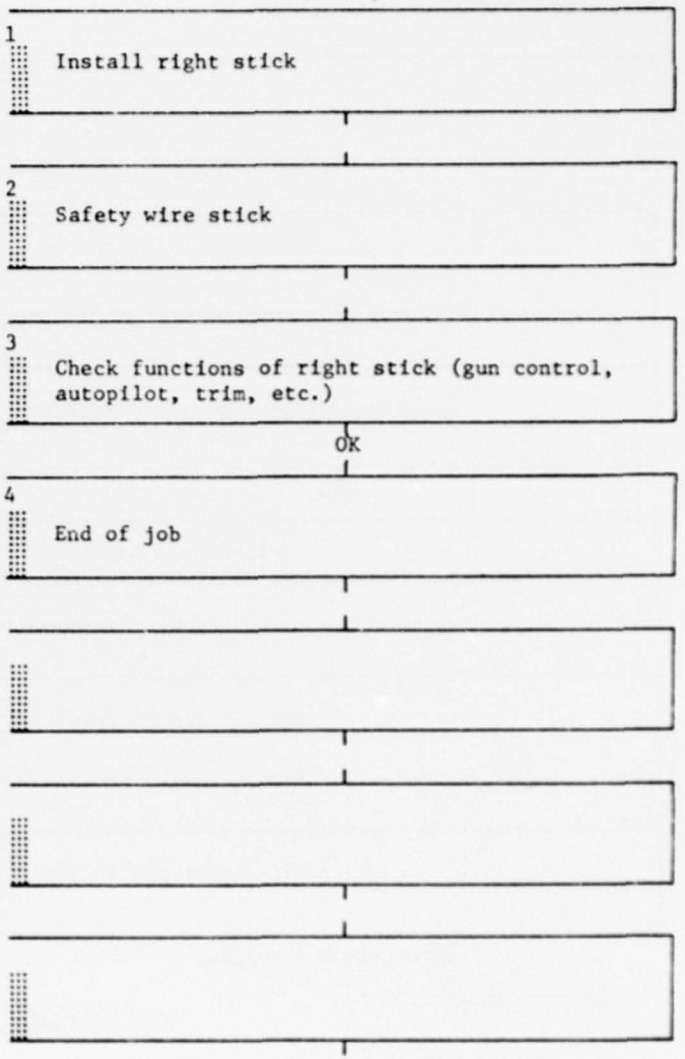
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No data this JCN. Only April flight on 4/3. It had no 14H problems.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 31 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0920752	0920752			
TM	B	B			
WUC	51 000	51 ABN			
AT	Y	P			
WD	D	D			
HM	374	374			
Start:	02:1755	02:1830			
Stop:	02:1830	02:1840			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The Angle of Attack tape on the Air Mach Indicator was reported inoperative. Malfunction was verified and AMI was removed.

The Tech Order was followed closely in task 3, the self-test. Tasks 2 and 4 were done from memory of procedures. All of these tasks were learned through OJT.

EXPERT COMMENT:

In step 3, the MM should have also performed an instrument self-test in addition to the CADC self-test.

AIRCRAFT FOLLOWUP:

TS found indicator to fail diagnostic/automatic test, but were not authorized to repair it (NRTS). Another indicator was installed. The aircraft had a 51A system discrepancy on the next sortie (51ABA).

Activity Sequence

1. Set up AGE (-60)
2. Turn on CADC (which receives inputs from AOA). Turned AOA probe.

Observed lack of tape movement

3. Performed CADC self-test

Failed

4. Removed Air Mach Indicator
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 32 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0920755				
TM	B				
WUC	51 ABM				
AT	Y				
WD	D				
HM	374				
Start:	02:1640				
Stop:	02:1910				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Standby Compass was reported with high error. Maintenance men verified that its performance fell outside acceptable tolerance.

All procedures and tolerances were drawn from memory. "How to" perform tasks 2 through 5 had been acquired through OJT.

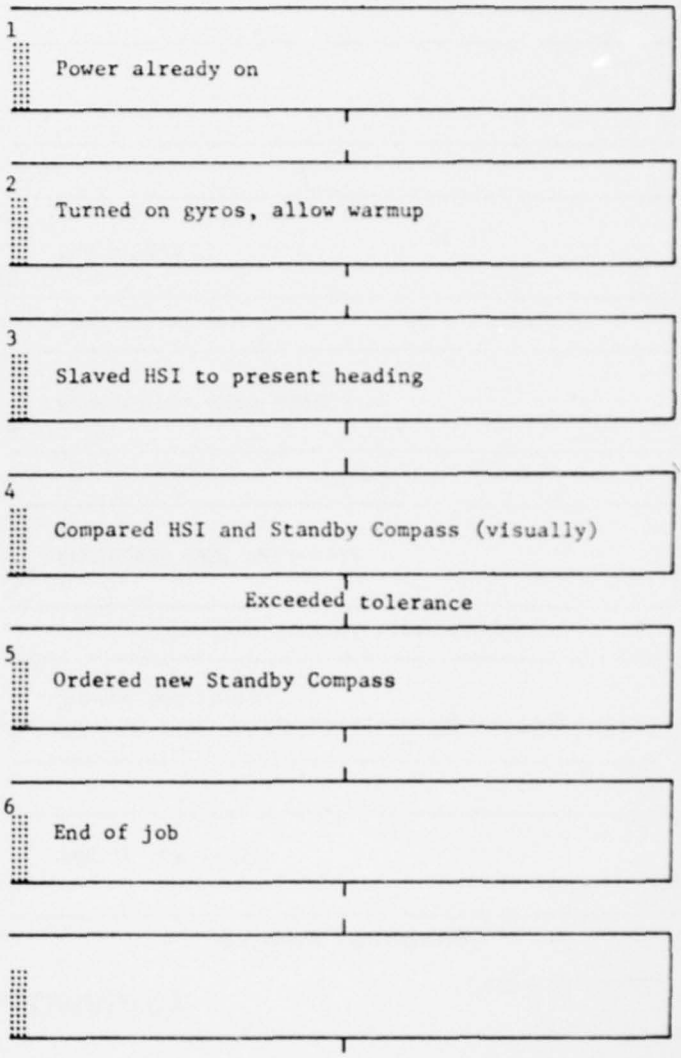
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

R&R completed later on same shift. Old unit bench checked--condemned by TS. How mal code = 255 (no output or incorrect output). Trouble in 51A system next sortie--standby altimeter read low (51ABA).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 33 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0900145				
TM	B				
WUC	51 ABA				
AT	L				
WD	F				
HM	127				
Start:	02:1910				
Stop:	02:1945				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Report of seal pulling out of the standby altimeter. Also that the altimeter read 400' low at all altitudes.

Altimeter was found to read low and was adjusted. Seal was judged to be OK.

The Tech Order was followed in detail. The task procedures had been learned in OJT.

EXPERT COMMENT:

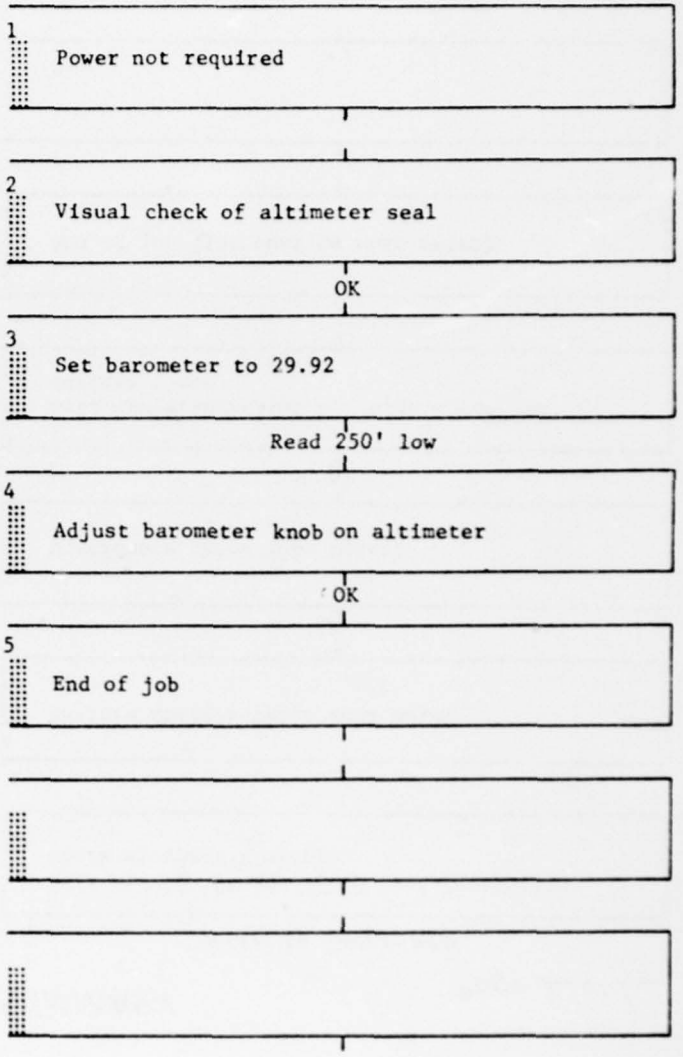
A visual check of the altimeter is insufficient. The MM should have performed leak test at step 2 and again at end of job.

The MM should have called tower for correct local baro reading instead of using normal sea level reading.

AIRCRAFT FOLLOWUP:

Next sortie reported discrepancies in system 510

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 34 Work Center B Shop System 46A

349 Data

	1	2	3	4	5
JCN	0900752				
TM	B				
WUC	46 AA0				
AT	Y				
WD	D				
HM	374				
Start:	01:1945				
Stop:	01:2355				
Skill	3,5,3				

NARRATIVE OF MAINTENANCE ACTION:

The aft fuel quantity pointer would not move but previous shift had cured this. However, it was stuck at 19,700 lbs. The aircraft history was checked; the problem had been CNDed twice before.

Three tests were performed with the TF 20 Test Equipment. The MM also used a check list developed by a shop sergeant. This chart related probable error amounts to particular problems.

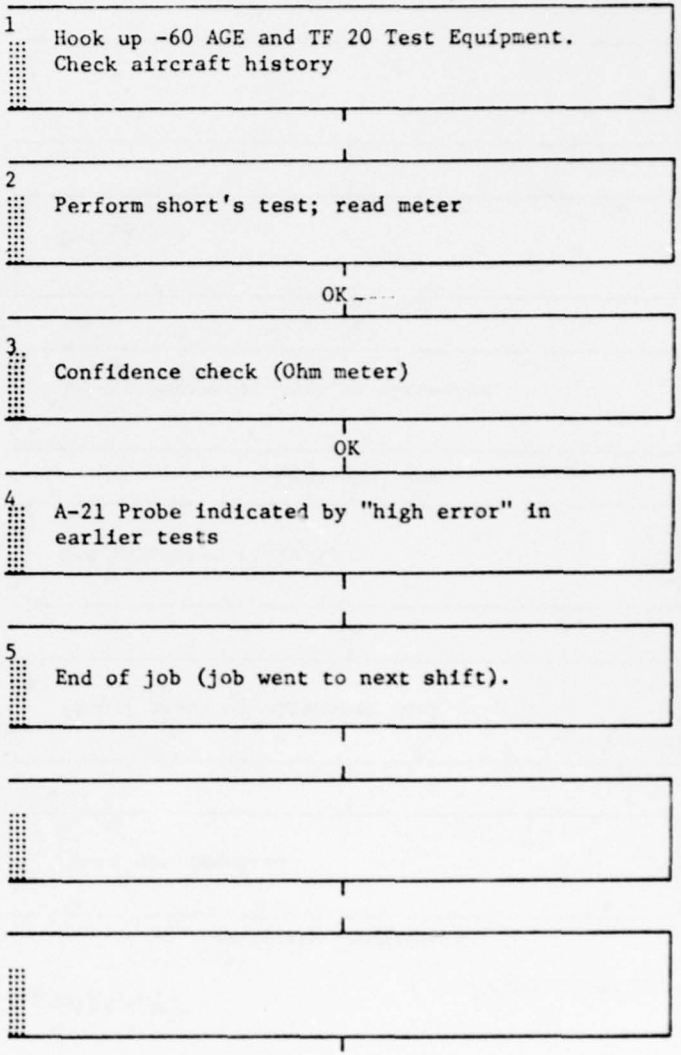
EXPERT COMMENT:

Both evaluators questioned how the MM had identified the A-21 probe as the trouble cause.

AIRCRAFT FOLLOWUP:

JCN listed, but no 349 listed for a maintenance action on 01:1945 to 01:2355. No 46A writeups next four flights.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 35 Work Center C Shop System 76K & M

349 Data

	1	2	3	4	5
JCN	006H084	006H084			
TM	P	P			
WUC	76MAO	76KHE			
AT	S	R			
WD	M	M			
HM	800	070			
Start:	02:1630	02:1700			
Stop:	02:1700	02:2015			
Skill					

NARRATIVE OF MAINTENANCE ACTION:

Two jobs were required: (1) remove the data analysis unit to facilitate other maintenance, and (2) install ECM Coax Cable.

Extensive use of the T.O. was made in Task 1 which had been learned in FTD. The other tasks, learned through OJT, were performed from memory of procedures.

EXPERT COMMENTS:

JSA.

AIRCRAFT FOLLOWUP:

JCN not listed. Next flight on 4/30--no 76 ___ problems.

Activity Sequence

1. Open panel; remove data anlysis unit (ALR-41; 76 MAO)
2. Open another panel to gain cable access
3. Wait for air duct removal (different shop)
4. Remove and install COAX cable
5. Reinstall DAU
6. End of job

FIELD OBSERVATION SUMMARY

Rand ID 36 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0920673				
TM	B				
WUC	14 HAA				
AT	S				
WD	F				
HM	800				
Start:	02:1935				
Stop:	02:2030				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Required to install the right stick. This was done, safety wired, and ops checked. The ops check required checking the operation in several functions. It was performed from memory--however, the T.O. was available if needed in case of a problem. (Coded as a remove and re-install.)

The tasks were learned in OJT.

EXPERT COMMENT

JSA

AIRCRAFT FOLLOWUP:

This is not listed among discrepancy reports. No 14H problems next sortie (on 4/4).

Activity Sequence

1 Set up -60 AGE

2 Installed right stick

3 Safety wire stick

4 Check, by operating, all stick functions

All OK

5 End of job

FIELD OBSERVATION SUMMARY

Rand ID 37 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0908041				
TM	C				
WUC	14 HAA				
AT	H				
WD	H				
HM	799				
Start:	02:2000				
Stop:	02:2040				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTIONS:

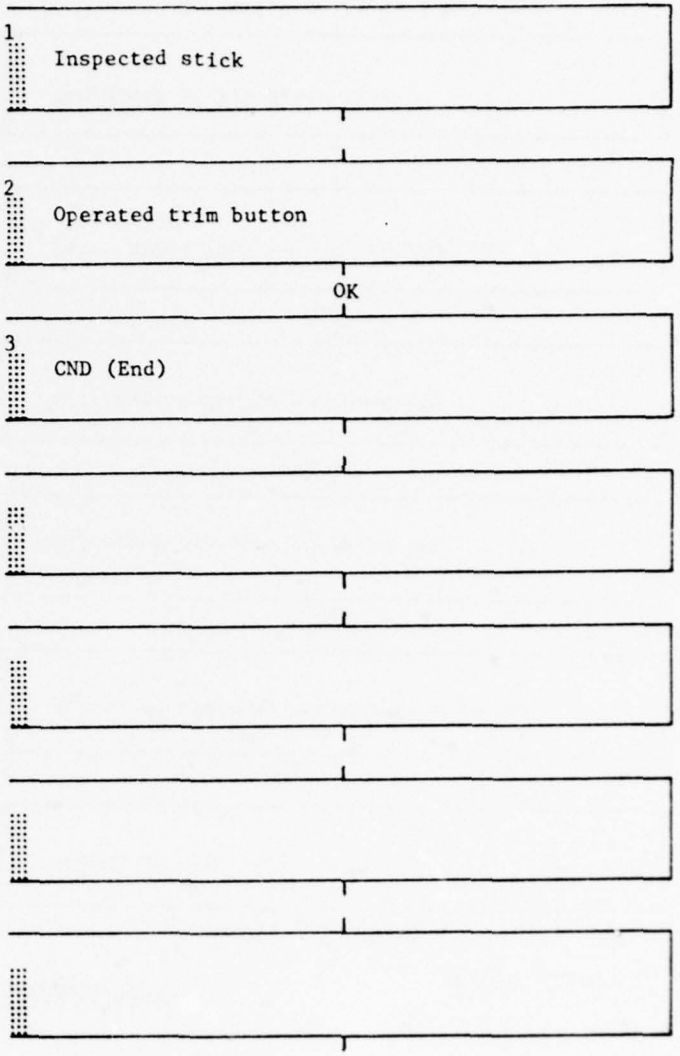
Trim button had been listed as loose on the left stick. Maintenance could not duplicate--trim button was OK.

No T.O. was used; the job was done from memory of procedures. Job had been learned in OIT.

AIRCRAFT FOLLOWUP:

Sortie on 4/4 did not report a 14H system problem.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 38 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0920700				
TM	B				
WUC	73HAO				
AT	P				
WD	D				
HM	242				
Start:	02:1600				
Stop:	02:1900				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Problem was stated as INS excessive drift. Maintenance man agreed following his check.

The Technical Order was closely followed. Tasks 2 through 6 had been taught at technical school. Tasks 7 and 8 were learned through OJT.

EXPERT COMMENT:

One expert said JSA. Two others felt that a 2-axis trim should also have been done in the INS checking.

AIRCRAFT FOLLOWUP:

TS bench checked and repaired; how mal code was 607. No discrepancy this system next sorties.

Activity Sequence

1. Hooked up AGE (-60, -10)

2. Turned on systems; observe BITE lites

OK

3. Addressed computer to check DCC

Good

4. Addressed computer to check INS

Good

5. Set: Align INS ——— Go to NAV mode

6. Performed 90 min drift test

Excessive drift in 1 hr.

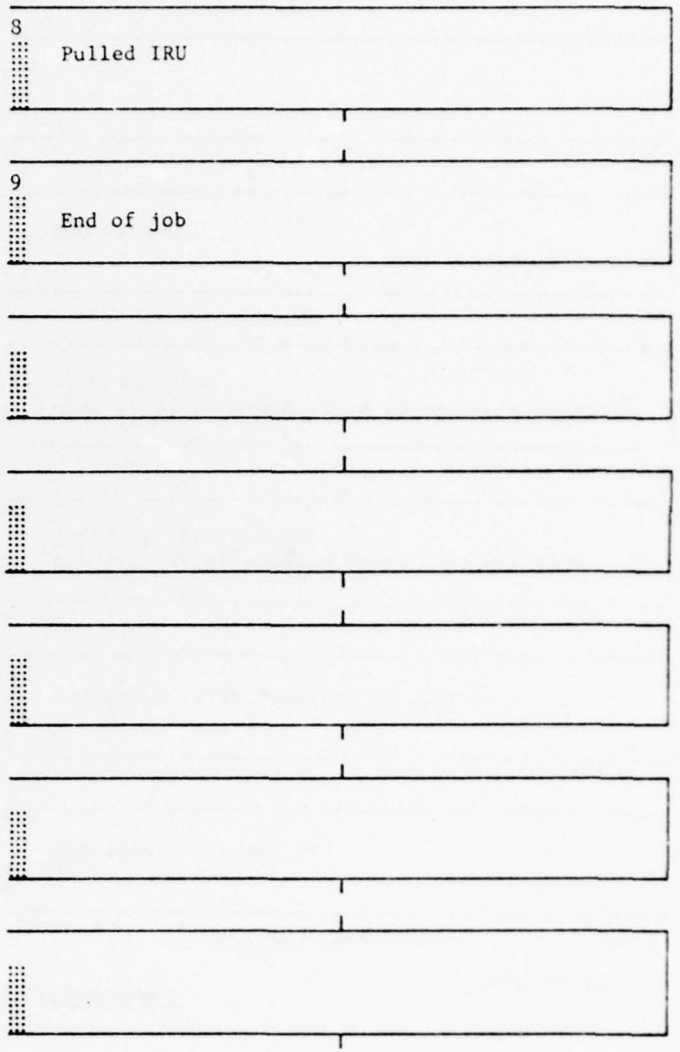
7. Verified INS still operating

OK

FIELD OBSERVATION SUMMARY

Rand ID 38 **Work Center** A Shop **System** 731I

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 39 Work Center B Shop System 140

349 Data

	1	2	3	4	5
JCN	0920501				
TM	B				
WUC	14 000				
AT	X				
WD	F				
HM	799				
Start:	02:1610				
Stop:	02:2100				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

This job was in assistance to the aircraft repair shop. Shop personnel assisted in turning on flight control computers and moving the control stick back and forth to assist this other crew, which was performing a pitch and roll superposition authority check after installing a control valve.

The Technical Order was followed in detail. All tasks were learned in OJT

AIRCRAFT FOLLOWUP:

No discrepancy report on next sortie (on 4/4).

Activity Sequence

1. AGE already hooked up
2. Turned on flight control computers
3. Checked valve; observe green take off trim light as trim changes
4. Move stick back and forth to assist aircraft recovery crew
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 40 Work Center C Shop System 76L

349 Data

	1	2	3	4	5
JCN	0910775				
TM	B				
WUC	76 L00				
AT	L				
WD	D				
HM	127				
Start:	022000				
Stop:	022145				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The report was of an infrared constant cryogenic system failure. It was determined to be a CND.

The Technical Order was followed in detail.

Switch locations (task 1) were learned at technical school. Knowledge of other tasks was acquired through both OJT and FTD.

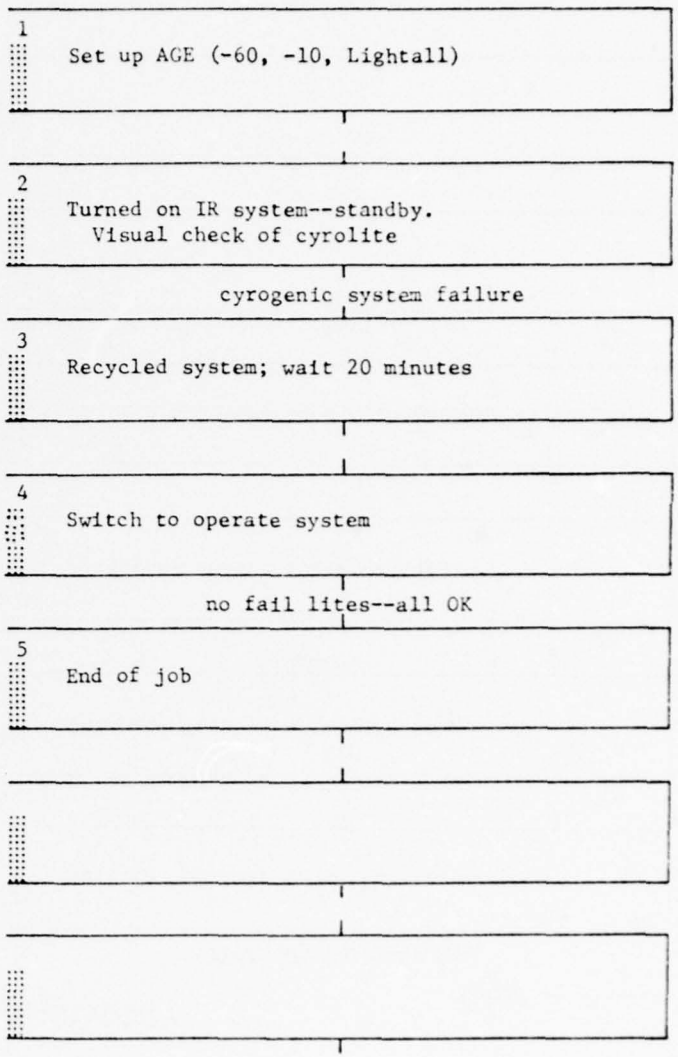
EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No 76L problems next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 41 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0920670				
TM	B				
WUC	73 REO				
AT	R				
WD	A				
HM	242				
Start:	02 1630				
Stop:	02 1915				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

A ground abort had occurred due to a HUD problem. A tech. rep advised replacement of the MSD, which was done. Both the HUD and MSD then checked out OK.

The Tech. orders were followed extensively in tasks 3 and 4, the ops checks. OJT was involved in all tasks, with FTD of value to performing task 4.

EXPERT COMMENT:

First--Replacement of MSD's is in T.O.s--no need to consult Tech. Rep.

Second--If T.O.s were followed, as stated, the correctness of the MM's conclusions cannot be evaluated, since the T.O.s indicate the correct conclusions (at decision points).

AIRCRAFT FOLLOWUP:

Thirty minutes after this R&R action ended "A" Shop undertook an X action (test, inspect, service). It lasted 15 minutes and "how mal" was coded "no defect." The TS then bench checked and repaired this 73 REO unit. Their "how mal" coded was 070 (broken). No write-up next sortie.

Activity Sequence

1. Started -60 AGE; other AGE already on
2. Followed Tech. Rep. advice to replace MSD
3. Performed check of HUD (visual)
4. Checked MSD; switched through various displays

good

5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 42 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0920917	0900771			
TM	B	B			
WUC	73 KKO	73 KKO			
AT	T	Q			
WD	F	D			
HM	799	799			
Start:	021915	021945			
Stop:	021945	022105			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

This aircraft was in the phase docks. The requirement was to cannibalize a TFR from one aircraft and transfer it to another.

These tasks were performed from memory. The procedures had been learned in OJT.

EXPERT COMMENT:

Both stated JSA.

AIRCRAFT FOLLOWUP:

No data on aircraft 8135.

Activity Sequence

1 Removed TFR computer from aircraft no. 135

2 Installed TFR Computer in aircraft no. 162

3 Operated TFR and associated systems

no fail lites, displays good

4 End of job

FIELD OBSERVATION SUMMARY

Rand ID 43 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0760734				
TM	B				
WUC	73 PAO				
AT	U				
WD	F				
HM	799				
Start:	022100				
Stop:	022200				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

This job consisted of the replacement of an ARS antenna which had been removed previously in a cannibalization action.

Installation procedures were done from memory of such installation during previous jobs.

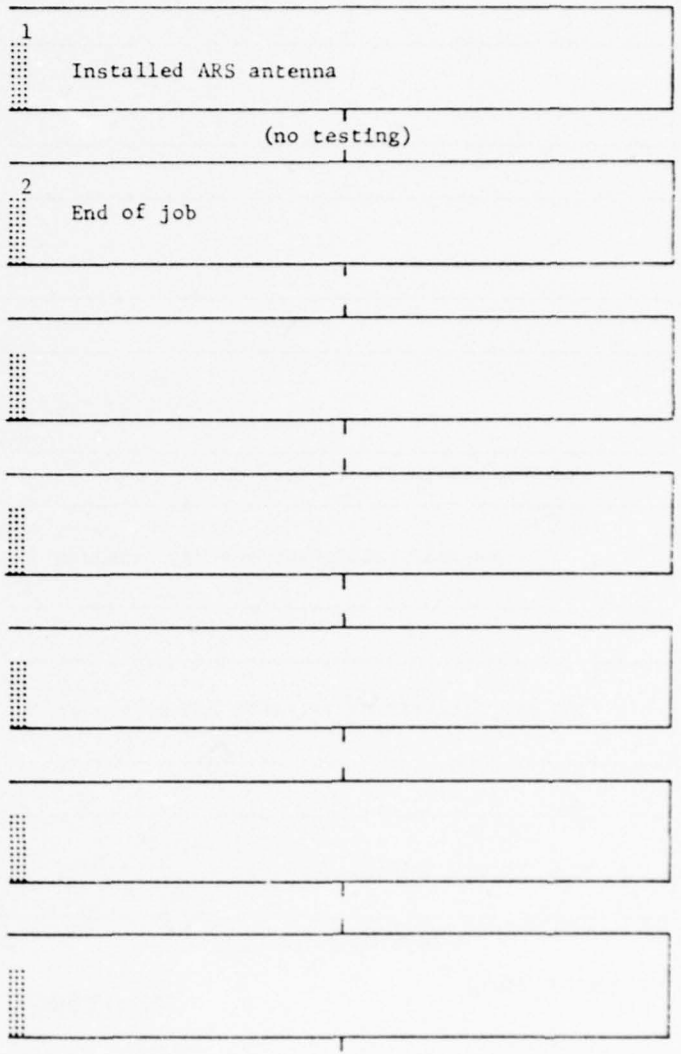
EXPERT COMMENT:

MM should not have done this job from memory.

AIRCRAFT FOLLOWUP:

No data this aircraft.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 44 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0920672				
TM	B				
WUC	73H00				
AT	L				
WD	A				
HM	472				
Start:	02:1630				
Stop:	02:2210				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Problems were reported with the weapon delivery computer. After extensive switching of boxes the maintenance man found the AC circuit breaker to be out. (He states he would have checked this sooner except that the Roadrunner maintenance man had claimed to have already checked those.)

The procedures were drawn from memory except task 8 when it was deemed wise to actually check the tech. order. Such use of the tech. order had been learned in Technical School.

The ops check of task 11, using computer code words, had been learned in FTD where tech reps had instructed.

Tasks. The use of the computer code words (numbers) to ops check in tasks 3, 5, 6, 7, and 11 were learned two years ago in FTD. Other tasks involving circuit breakers were learned in OJT.

AGE training came late, after OJT use of the AGE.

Activity Sequence

1. Set up AGE: -60, -10, Lightall

2. Turn on DCC; Addressed computer to seek failed LRU

GNC OK, WDC down

3. Addressed computer again--to check converter set

Blanks - C/S or WDC down

4. Checked DC circuit breakers

OK

5. Switched C/S and checked; had constant S bit on ATP

Still down

6. Switched WDC and checked

Blanks; WDC not on

7. Swapped NDEP and checked

No help

FIELD OBSERVATION SUMMARY

Rand ID 44 Work Center A Shop System 73H

NARRATIVE OF MAINTENANCE ACTION: (cont.)

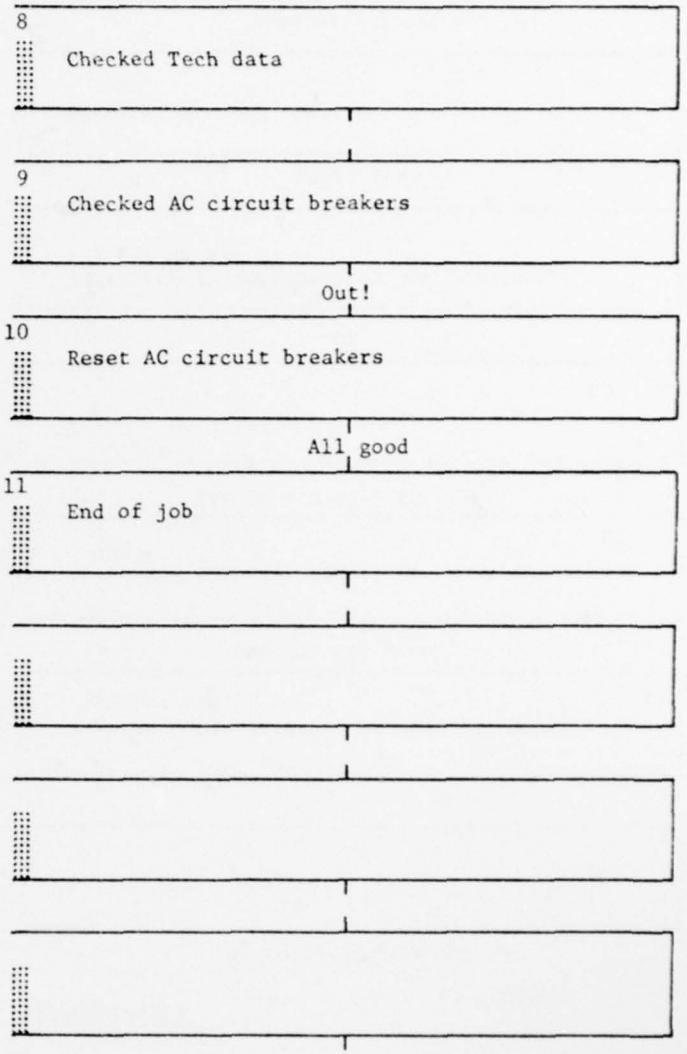
EXPERT COMMENT:

One felt that the AC circuit breakers should also have been checked sooner; the other responded JSA.

AIRCRAFT FOLLOWUP:

No discrepancy re 73H next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 45 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0910744				
TM	B				
WUC	73 PBO				
AT	R				
WD	D				
HM	242				
Start:	021800				
Stop:	022200				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Discrepancy report: when beacon submode was selected, the ARS would be lost. Finally solved by EPU replacement.

The Tech. Order was not followed by actual reading while working except in task 7; other task procedures were from memory. All tasks were learned in a combination of MISD and OJT.

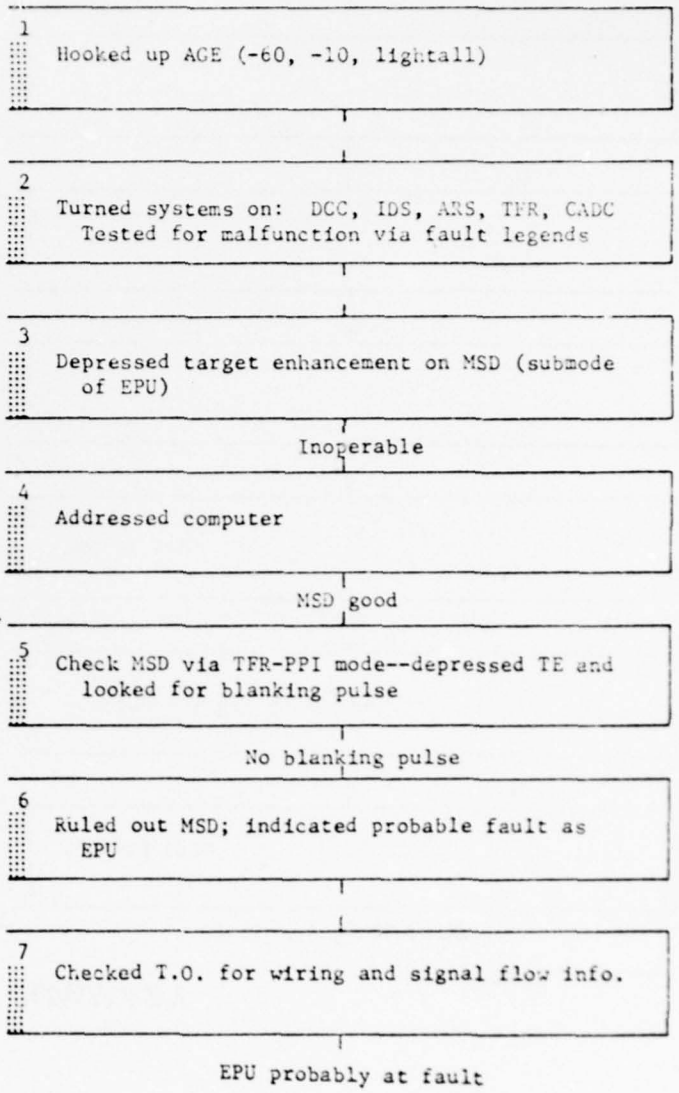
EXPERT COMMENT:

One felt that the write-up was not understandable. The second expert felt that it was understandable, however blanker might have been at fault in step #6 and the nature of the fail lites in step 2 was not clear.

AIRCRAFT FOLLOWUP:

TS station BC-serviceable (no defect). No discrepancy re 73P next sortie.

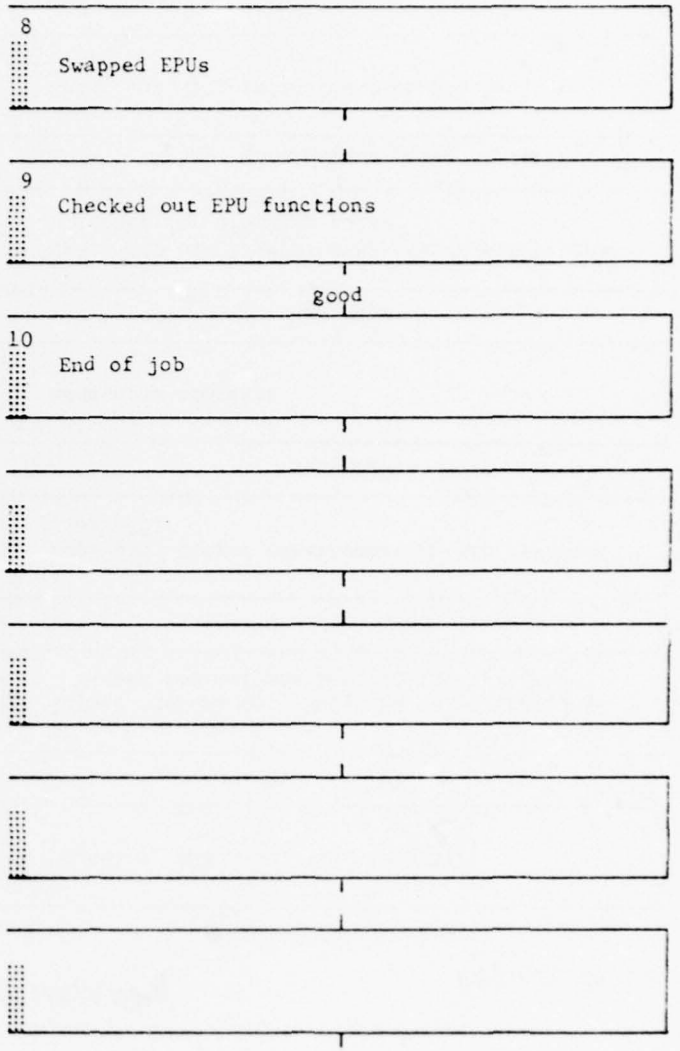
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 45 Work Center A Shop System 73P

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 46 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0920681				
TM	B				
WUC	73RGO				
AT	S				
WD	F				
HM	800				
Start:	02:2100				
Stop:	02:2340				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The VSD was removed to facilitate other maintenance and then reinstalled.

Procedures were taken from memory; knowledge had been acquired from OJT.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No data--first April launch with any discrepancy on 4/18; no 73R write-up resulted.

Activity Sequence

1 Remove VSD

2 Reinstall VSD

3 End of job

FIELD OBSERVATION SUMMARY

Rand ID 47 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	092F160				
TM	P				
WUC	52 AAF				
AT	S				
WD	M				
HM	800				
Start:	02:2110				
Stop:	02:2250				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Required to install roll rate gyro and ops check afterwards. Coded as a remove and reinstall.

All procedures were performed from memory of proper steps. Tasks 1 and 2 were learned in OJT while in the other tasks, performance was improved as OJT supplemented Tech School knowledge.

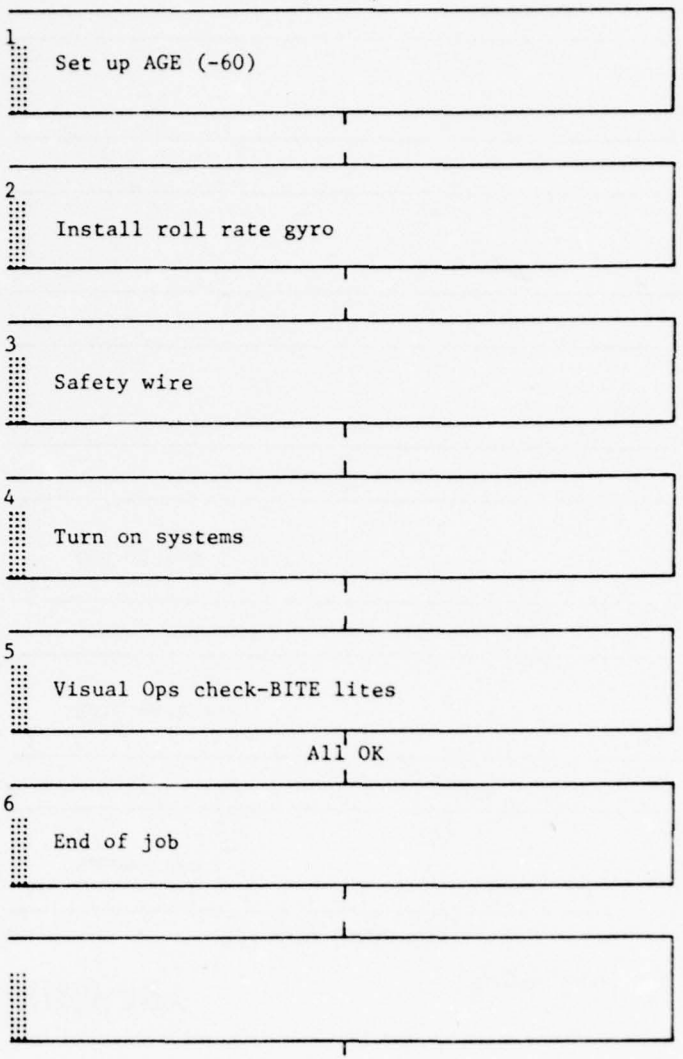
EXPERT COMMENT:

MM should have done 1) a gyro speed ops check on roll computers and 2) condition test on roll computer.

AIRCRAFT FOLLOWUP:

No record of this JCN. No 52A problems next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 48 Work Center C Shop System 76D

349 Data

	1	2	3	4	5
JCN	0770718				
TM	B				
WUC	76DDO				
AT	Q				
WD	D				
HM	799				
Start:	03:0915				
Stop:	03:1100				
Skill	5, 3				

NARRATIVE OF MAINTENANCE ACTION:

Forward receiver was installed. Ops check deferred. Procedures of installation were from memory; tasks knowledge gained via OJT.

EXPERT'S COMMENTS:

JSA

AIRCRAFT FOLLOWUP:

Next flight (4/4) had no 76D problems.

Activity Sequence

1 Installed forward receiver

2 End of job--ops check due

FIELD OBSERVATION SUMMARY

Rand ID 50a Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0640739				
TM	B				
WUC	73H00				
AT	X				
WD	D				
HM	799				
Start:	03:1100				
Stop:	03:1145				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

An ops check of the DCC was required. The ATP lites are controlled by select switches and a press to test button. The T.O. was followed closely in tasks 3 and 4. Tasks 1 and 2 were done from memory. All procedures (operations and decisions) were learned via OJT.

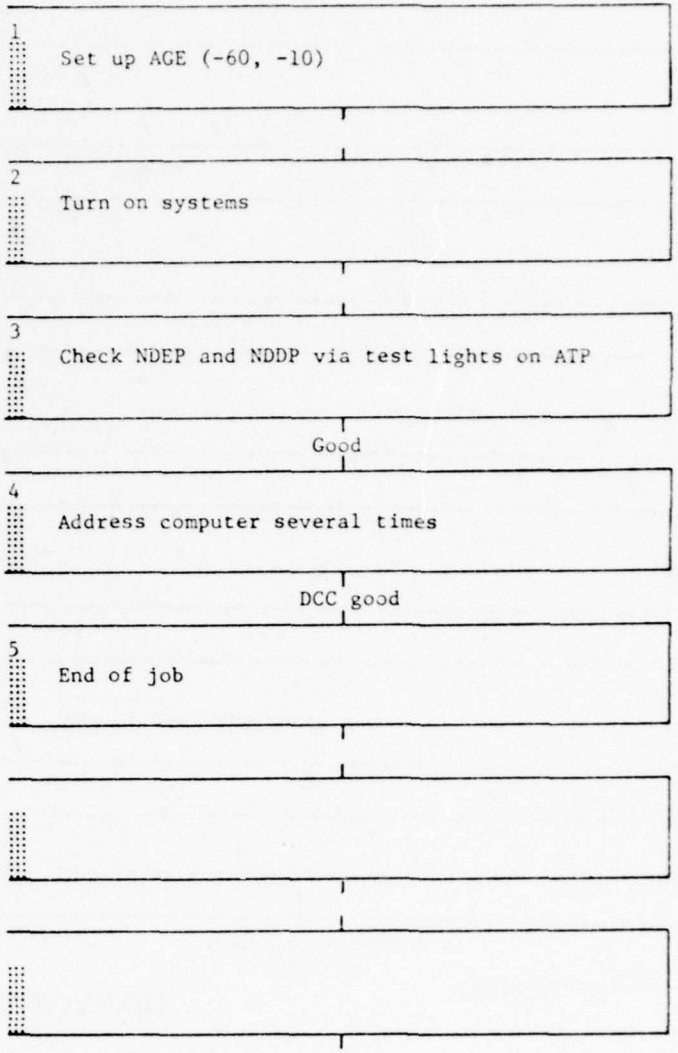
EXPERT COMMENT:

This does not describe a complete ops check of the DCC; however, these procedures could have been sufficient--depending on the original problem. A second comment was JSA.

AIRCRAFT FOLLOWUP:

No data this aircraft between 3-21 and 4-22. No 73H discrepancy on sortie of 4-22.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 50b Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0640742				
TM	B				
WUC	73 P00				
AT	H				
WD	D				
HM	812				
Start:	031145				
Stop:	031250				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

An ARS which had no A/A Sweeps had been cleared by Roadrunner earlier, but an ops check was still due. The ARS checked out good.

All tasks were performed by memory based on knowledge gained through OJT.

EXPERT COMMENT:

Both JSA.

AIRCRAFT FOLLOWUP:

No data; lst Apr flight on 4/22. A 73P write-up resulted from that sortie but no 349 resulted.

Activity Sequence

1. AGE already hooked up
2. Systems already on (except ARS)
3. ARS now turned on
4. Selected ARS display on MSD
5. Transmit with ARS; observe sweeps

OK

6. Checked in a/a modes

Video and sweeps OK

7. Addressed computer

ARS OK; End of job

FIELD OBSERVATION SUMMARY

Rand ID 51 Work Center A Shop System 73N

349 Data

	1	2	3	4	5
JCN	0640743				
TM	B				
WUC	73 NAO				
AT	R				
WD	D				
HM	242				
Start:	031230				
Stop:	031400				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report stated that the Horizontal Situation Display (HSD) jittered constantly. Maintenance action, turned over to new crew at shift change, indicated a need to replace the HSD indicator.

Initial operation of the HSD was done from memory. The use of code numbers to check out the HSD was from the tech order. All tasks were learned through OJT.

EXPERT COMMENT:

Should have reported a BIT check of HUD via the ATP early in the sequence of operations here.

AIRCRAFT FOLLOWUP:

No data--next sortie listed was on 4/22. No 73N trouble report that sortie.

Activity Sequence

1. Power already on
2. Operated HSD
3. Pulled out manual slew switch; visually checks display

Display jitters; use ATP for HSD BIT test

4. Address computer (23094)

HSD good

5. Address computer twice: 23905, 23907

All indicate HSD good

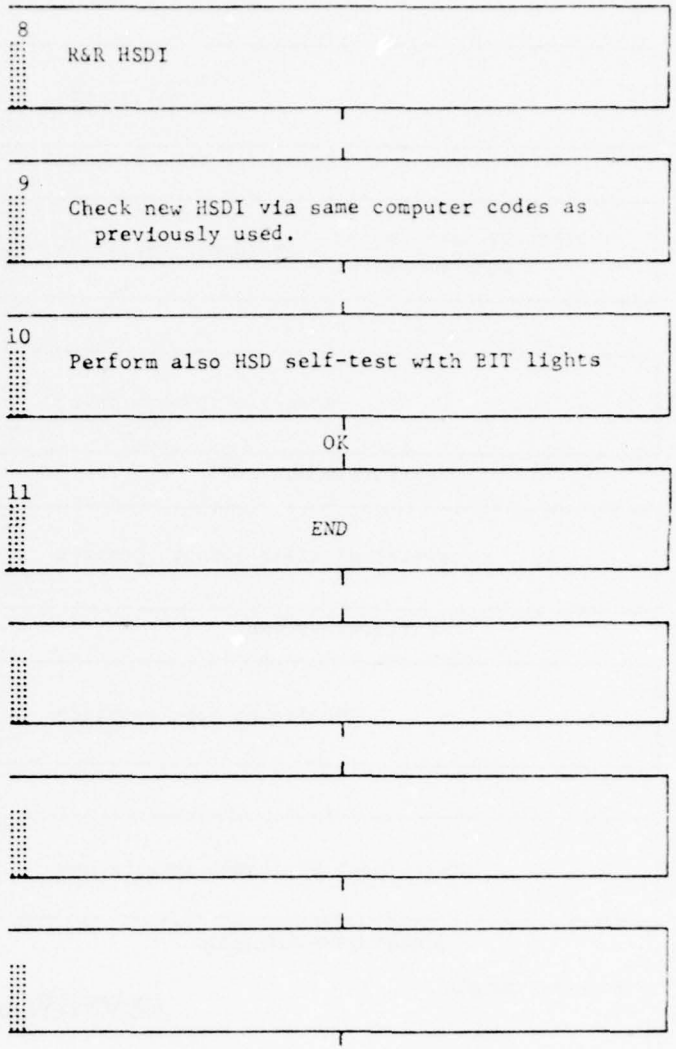
6. Experience points to HSD indicator as very probable fault
7. Advised R&R of HSDI to next crew

(NEW CREW AT THIS POINT)

FIELD OBSERVATION SUMMARY

Rand ID 51 **Work Center** A Shop **System** 73N

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 52 Work Center C Shop System 640

349 Data

	1	2	3	4	5
JCN	0930735				
TM	B				
WUC	64 000				
AT	L				
WD	D				
HM	472				
Start:	031330				
Stop:	031445				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

The left seat interphone was reported inoperative. A circuit breaker needed to be reset.

The location of the circuit breakers was determined by reference to the T.O. (task 3). No T.O. was used in tasks 1 and 2, while tasks 4 and 5 were detailed in a T.O. but performed from memory. All tasks were learned via OJT or were obvious procedures.

EXPERT COMMENT:

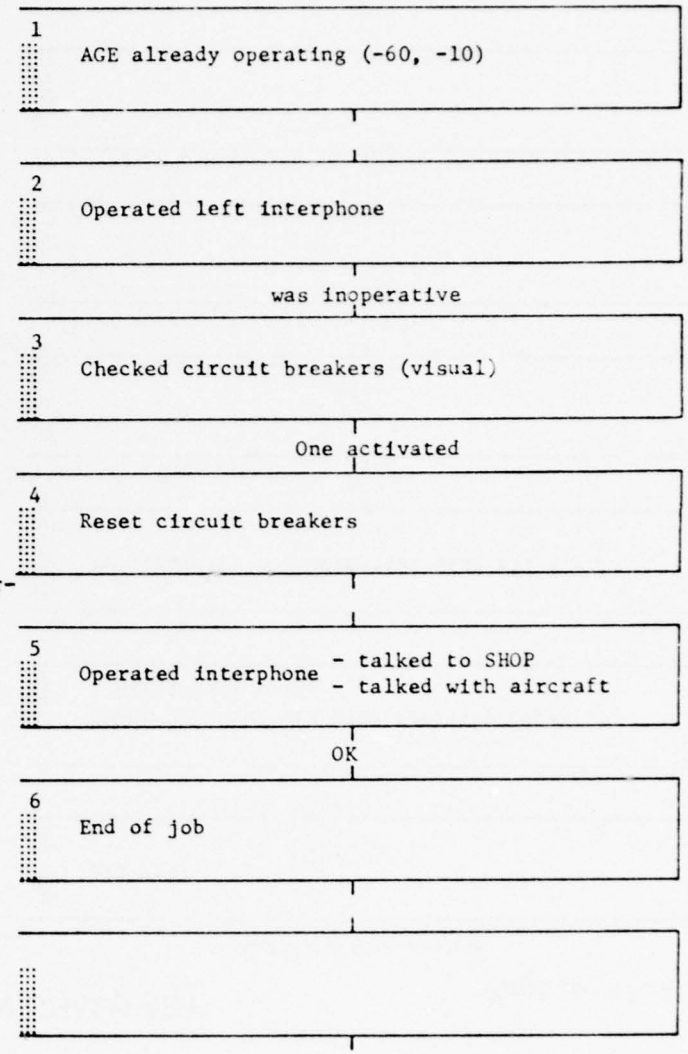
First--OK except that the PE lead should have been checked before opening panels.

Second--Perhaps should have checked system more thoroughly.

AIRCRAFT FOLLOWUP:

No repeat write-up next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 53 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0920767				
TM	B				
WUC	73SCO				
AT	Q				
WD	D				
HM	799				
Start:	03:1430				
Stop:	03:1600				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Required to install a navigation data display panel (NDDP).

Procedures for installation and ops check were drawn from memory.

The tasks knowledge was obtained through OJT.

EXPERT COMMENT:

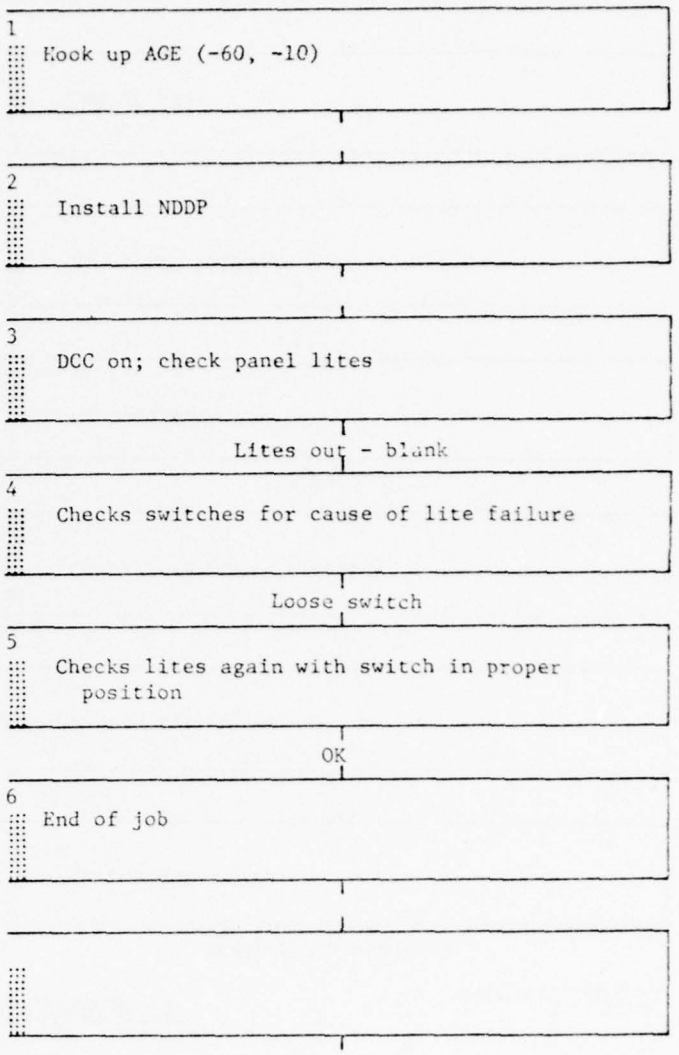
First--Further ops checks required. MM must interpret numeric computer display.

Second expert--JSA

AIRCRAFT FOLLOWUP:

349 listing shows this action and an "X" action (test, inspect, etc.) occurring during this same maintenance time interval (from 1500 to 1545). No 73S write-up after next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 54 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0930734	0930734			
TM	B	B			
WUC	73RA0	73 RA8			
AT	P	Q			
WD	D	D			
HM	242	799			
Start:	03:1310	03:1415			
Stop:	03:1415	03:1530			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

The discrepancy stated that the left HUD was cocked. This was verified and it was removed.

The maintenance was performed according to memory of procedures.

The operation (task 1) of the HUD was learned in FTD but the removal and installation of ballast learned through OJT.

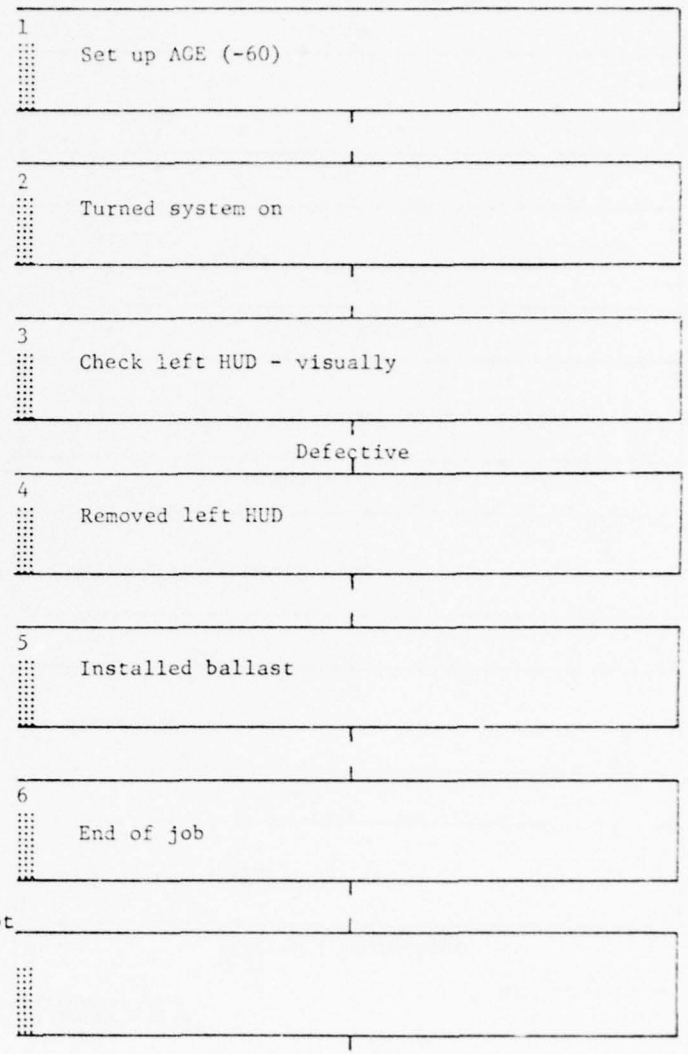
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

Two TS actions followed this removal. The first involved a bench check with repair deferred; the second the repair. The malfunction was coded "shorted." Apparently, the HUD was not installed until after the next flight. No write-up resulted after its reinstallation.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 55 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0921001				
TM	B				
WUC	73 K00				
AT	X				
WD	F				
HM	799				
Start:	031600				
Stop:	031630				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This job was picked up from the day crew--an ops check of the TFR following a TCTO. After an adjustment, the TFR checked good.

The maintenance procedures were done from memory. All tasks and decisions were learned through MISD and OJT.

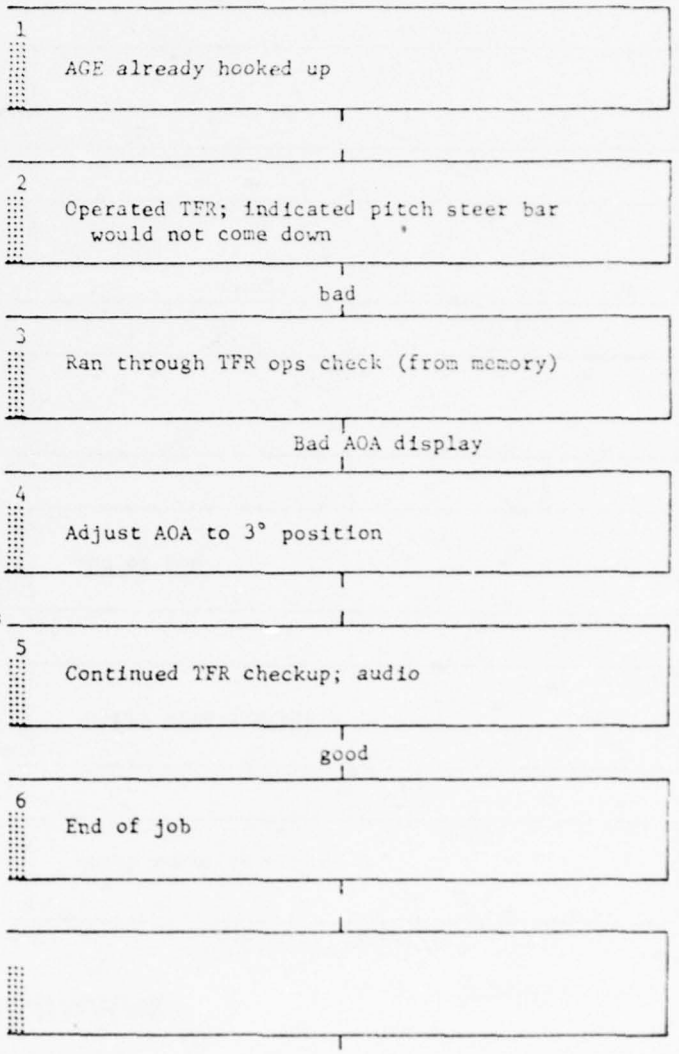
EXPERT COMMENT:

Both stated JSA.

AIRCRAFT FOLLOWUP:

No record of this job in debrief-349 data printout. No 73K work required after the next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 56 Work Center C Shop System 71B

349 Data

	1	2	3	4	5
JCN	0930854				
TM	B				
WUC	71 BAO				
AT	G				
WD	D				
HM	108				
Start:	031630				
Stop:	031730				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Requirement was to safety wire the TACAN.

No T.O. was used.

Instructions regarding both tasks came from FTD and also OJT in the case of task 2.

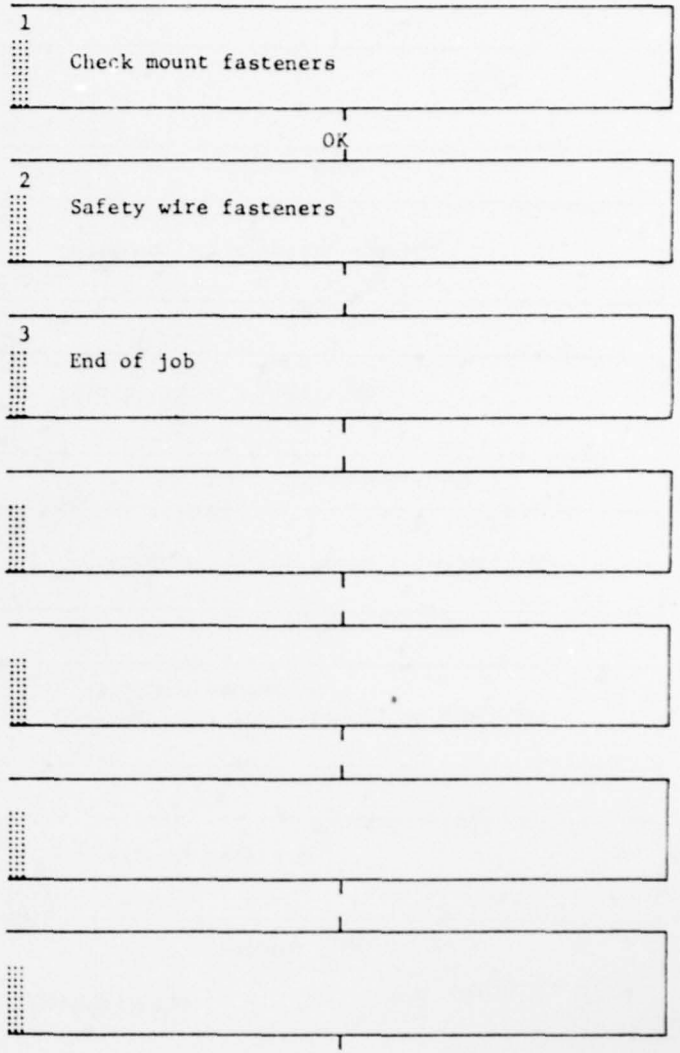
EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No 71B discrepancy next flight (4/14).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 57 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0930421				
TM	B				
WUC	14 HAJ				
AT	P				
WD	F				
HM	127				
Start:	03:1600				
Stop:	03:1740				
Skill	5,5,5				

NARRATIVE OF MAINTENANCE ACTION:

The flap/slat indicator had been reported sticking. It was replaced.

Replacement procedure did not require actual reference to the technical order.

The task had been learned through OJT.

AIRCRAFT FOLLOWUP:

No data in discrepancy listing for a/c 8112.

Activity Sequence

1 Remove flap/slat window indicator

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 58 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0920752				
TM	B				
WUC	51 ABN				
AT	X				
WD	D				
HM	799				
Start:	03:1705				
Stop:	03:1800				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Required to ops check the Air Speed Mach Indicator. This consisted of observing the display while operating.

No tech order was read while the tasks were performed.

The task procedure had been learned in OJT.

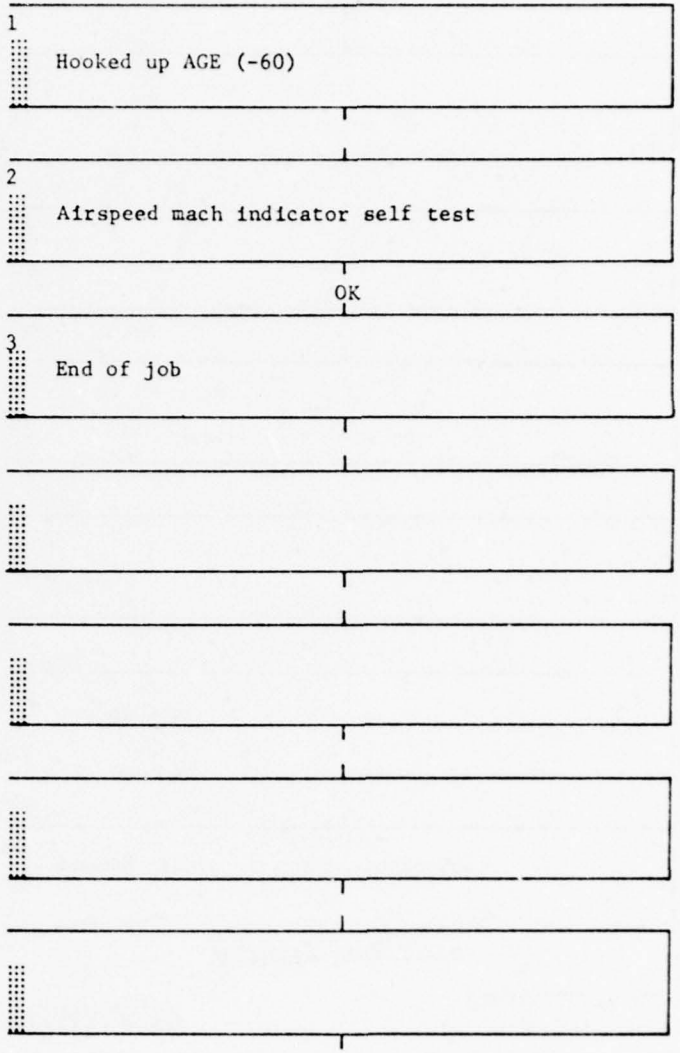
EXPERT COMMENT:

Both evaluators recommended a CADC self-test in addition to step 2.

AIRCRAFT FOLLOWUP:

Discrepancy next sortie on system 510.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 59 Work Center C Shop System 61A

349 Data

	1	2	3	4	5
JCN	0920773				
TM	B				
WUC	61 ACO				
AT	P				
WD	D				
HM	080				
Start:	031730				
Stop:	031830				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Improper lighting was present on the High Frequency Control Box Panel. The box was removed and ballast installed.

The procedure was known without T.O. reference.

Instruction regarding this job had been received through the FTD and through OJT.

EXPERT COMMENT:

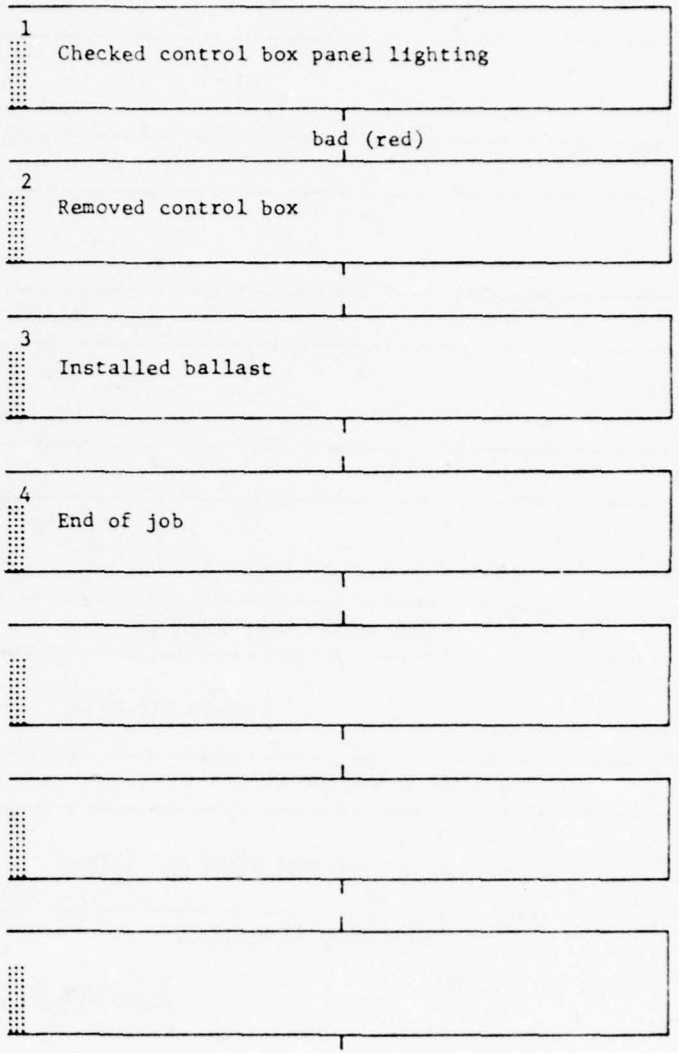
First--JSA.

Second--MM should have tried another box to see if wiring was good.

AIRCRAFT FOLLOWUP:

Next flight on 4/4 did not result in 61A discrepancy report.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 60 Work Center 24370 System 71C

349 Data

	1	2	3	4	5
JCN	0920772				
TM	B				
WUC	71 COO				
AT	H				
WD	D				
HM	812				
Start:	03 1700				
Stop:	03 1730				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

The report was lack of an ILS display. Investigation revealed that A Shop had fixed the DCC problem of the aircraft and that this ILS problem no longer existed.

EXPERT COMMENT:

1st--JSA.

2nd--Not clear what MM did. Very possibly he accepted A Shop's word that the ILS problem had been corrected.

AIRCRAFT FOLLOWUP:

Record shows only one A Shop action following a 73H discrepancy report; result was an R&R of the Flight Director System Coupler (51BBO). The TS could find no defect. No further 71C discrepancies arose in April sorties.

Activity Sequence

1 Sought to learn problem source

Learned from A Shop

2 Found ILS OK now

"A" Shop action had corrected

3 End of job

FIELD OBSERVATION SUMMARY

Rand ID 61 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0920910	0920910			
TM	B	B			
WUC	73HCO	73HCO			
AT	U	T			
WD	F	F			
HM	799	799			
Start:	03:1630	03:1700			
Stop:	03:1700	03:1730			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

Cannibalize NCU from one aircraft for installation in another.

Procedures were from memory; training through OJT.

EXPERT COMMENT:

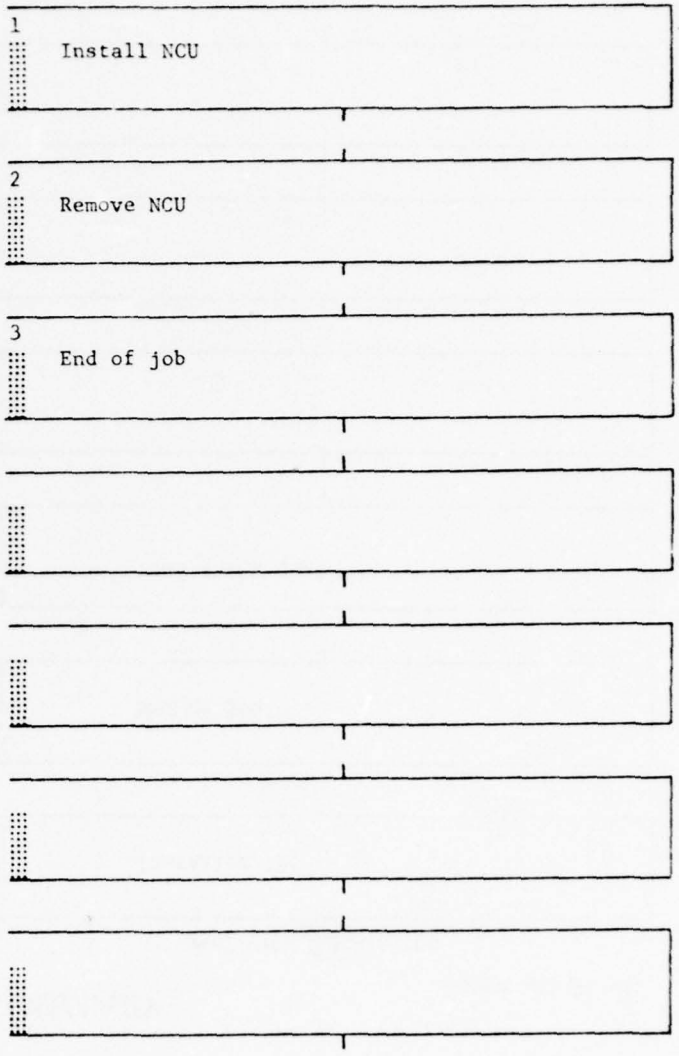
Final 349 records show no time on the installation but 25 minutes on the removal (at a different time (11:20 to 11:45)).

This was probably a "paper" action--without either an installation or removal actually occurring. The cannibalization records will now show an installation into a/c 148 and a removal from the same a/c.

AIRCRAFT FOLLOWUP:

No data re a/c 148.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 62 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0910765				
TM	B				
WUC	73 HAO				
AT	Q				
WD	F				
HM	799				
Start:	03:1800				
Stop:	03:1830				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The MM was to install the Inertial Reference Unit. He did so; the ops check was to be done later.

The work was done from memory of procedures which were learned while on the job.

EXPERT COMMENT:

This job should not have been done from memory as the torque settings are critical.

AIRCRAFT FOLLOWUP:

TS "action taken" was "A"; how malfunction was 607 (no go indication--reason unknown).

This system had a discrepancy write-up after the next flight.

Activity Sequence

1 Installed IRU

2 End of job

3 (Ops check due)

FIELD OBSERVATION SUMMARY

Rand ID 63 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0922122				
TM	P				
WUC	73KKO				
AT	Q				
WD	M				
HM	800				
Start:	031605				
Stop:	031845				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This installation, done while the aircraft was in the phase docks, was easy to perform without a T.O. to follow. It hardly requires any special training at all.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No record this JCN in debrief-349 data; no 73K work next flight.

Activity Sequence

1 Installed TF computer

2 End of job (Ops Check due)

FIELD OBSERVATION SUMMARY

Rand ID 64 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	2540019				
TM	B				
WUC	52 ADA				
AT	Q				
WD	F				
HM	799				
Start:	03:1600				
Stop:	03:1800				
Skill	5,3,3				

NARRATIVE OF MAINTENANCE ACTION:

This involved the installation of a feel and trim assembly (one box about 1 cu. ft. in volume).

It was installed by reliance on memory regarding the procedures which had been learned in OJT.

EXPERT COMMENT:

Should have ops checked the feel and trim assembly.

AIRCRAFT FOLLOWUP:

No data on aircraft 8094.

Activity Sequence

1 Install feel and trim assembly

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 65 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0500003				
TM	B				
WUC	52 A00				
AT	X				
WD	F				
HM	799				
Start:	03:1745				
Stop:	03:1900				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

This job consisted of checking the flight controls during an engine run. It involves checking caution lights, a stabilization augmentation check (10 pp in T.O.), a flight control quick check (23 pages in T.O.), and a check of the TFR tie-in. T.O. use was from memory; training was OJT.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No date prior to 4/13. System 52A had discrepancy report on sortie on that date.

Activity Sequence

1. Crew chief started engines
2. MM turned on flight control computers, CADC, and gyros
3. Pushed damper reset
4. Performed visual checks of 8 caution lights

OK

5. Performed stabilization augmentation check

OK

6. Performed Flight Control Quick Check. Turn engines off

OK

7. Performed TFR tie-in; checked visually stabilizer movement in auto TF mode

OK; End of job

FIELD OBSERVATION SUMMARY

Rand ID 68 Work Center C Shop System 76D

349 Data

	1	2	3	4	5
JCN	0930707				
TM	B				
WUC	76DCO				
AT	L				
WD	D				
HM	635				
Start:	03:1800				
Stop:	03:1900				
Skill	5, 3				

NARRATIVE OF MAINTENANCE ACTION:

A report showed a mode failure on RHAWS. The system would be CND, but to avoid the need for a 7-level check, the sensitivity was adjusted on the ICU.

The T.O. was followed in ops checking this installation.

Job procedures were learned both at the FTD and OJT.

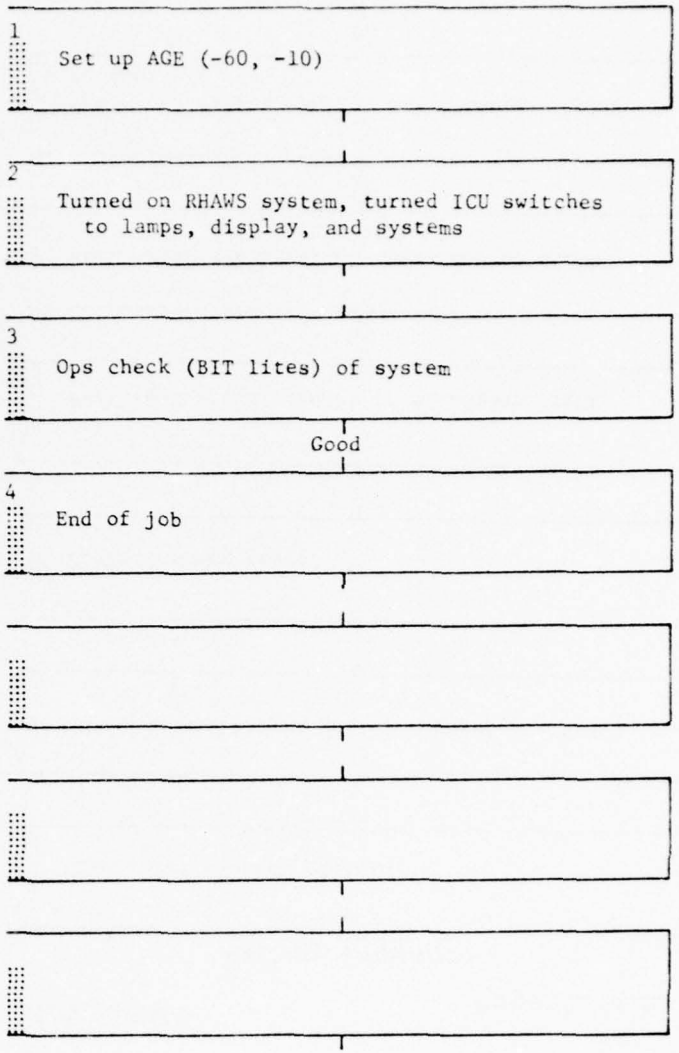
EXPERT'S COMMENTS:

JSA

AIRCRAFT FOLLOWUP:

No additional 349s. No 76D problem next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 69 Work Center C Shop System 76K

349 Data

	1	2	3	4	5
JCN	0930708				
TM	B				
WUC	76 K00				
AT	L				
WD	D				
HM	001				
Start:	031900				
Stop:	032000				
Skill	3,5				

NARRATIVE OF MAINTENANCE ACTION:

The discrepancy was a flashing power amplifier (PA) lite on the Med. Band setting.

After recycling the unit operated normally (OCG).

The Tech. Order was followed closely. Both FTD and OJT provided pertinent training.

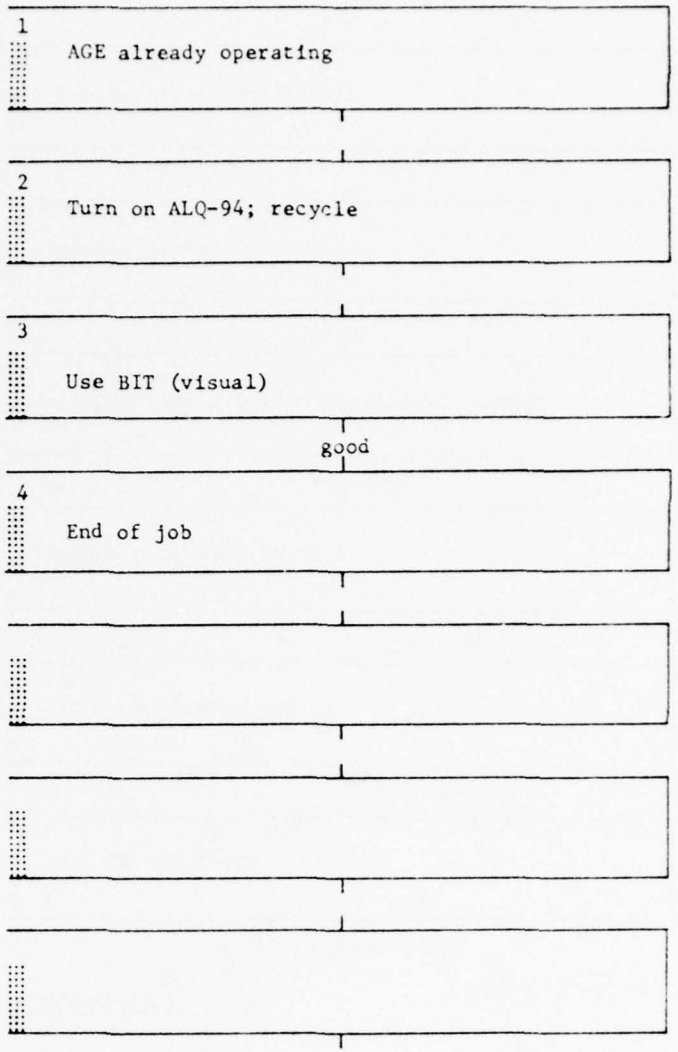
EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No problem with 76K next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 70 Work Center B Shop System 51C

349 Data

	1	2	3	4	5
JCN	0930670	0930670			
TM	B	B			
WUC	51 CAC	51 CCO			
AT	R	R			
WD	F	F			
HM	374	374			
Start:	03:1600	03:1815			
Stop:	03:1815	03:2030			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

An AFRS problem was reported. It would not stay on line; also flag comes into view.

All tasks were performed by memory. OJT provided the crucial education and hands-on experience.

AGE training came late for one crew member, after learning it in OJT.

No 349 form is listed in BLIS da[illegible] or job 1, the gyro replacement.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

These actions are completely missing from the aircraft history. No 51C problem on next flight (on 4/14).

Activity Sequence

1. Set up AGE (-60)
2. Turn on gyros--AFRS
3. Observe display on HSI

Not good

4. Checked and replaced Electronic Control Amplifier

Bad

5. Remove Directional Gyro
6. Install Directional Gyro
7. Ops check--repeat #3

Good; End of job

FIELD OBSERVATION SUMMARY

Rand ID 71 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0920680				
TM	B				
WUC	73HPO				
AT	Q				
WD	F				
HM	799				
Start:	03:1600				
Stop:	03:1800				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

The avionics test panel (ATP) lights indicated a computer-nav.-weapon failure. The converter set was suspect but had just been installed. Confusing results from the computer addressing caused the MM to consult the Tech. Rep. (about Task 6). He suggested R&R of the GNC, but this did not solve the problem. It remained for further troubleshooting after the flight.

All tasks performed by the MM were drawn from memory. They were learned while on the job.

EXPERT COMMENT:

Both reviewers felt that C/S should have been replaced sooner; that one cannot trust a newly installed LRU. One commented that there was no need to check INS here.

AIRCRAFT FOLLOWUP:

No a/c data until 4-7; no 73H system discrepancy on that sortie.

Activity Sequence

1 Hooked up -60, -10 AGE

2 Converter set was out; installed c/s

3 Turned on systems

ATP lite came on

4 Addressed computer twice

Both indicate c/s failure

5 R and R GNC

No improvement

6 Removed & reinstalled GNC

7 Terminated maintenance action due to flight requirement.

End of Job

FIELD OBSERVATION SUMMARY

Rand ID 72 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	092B122				
TM	P				
WUC	52 AAF				
AT	S				
WD	M				
HM	800				
Start:	03:1900				
Stop:	03:2110				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Involved installation of a roll rate gyro; a few screws, a cannon plug, and safety wiring. The safety wiring had been discussed in technical school. It was coded as a remove and reinstall.

All other aspects of this job were done from memory based on OJT.

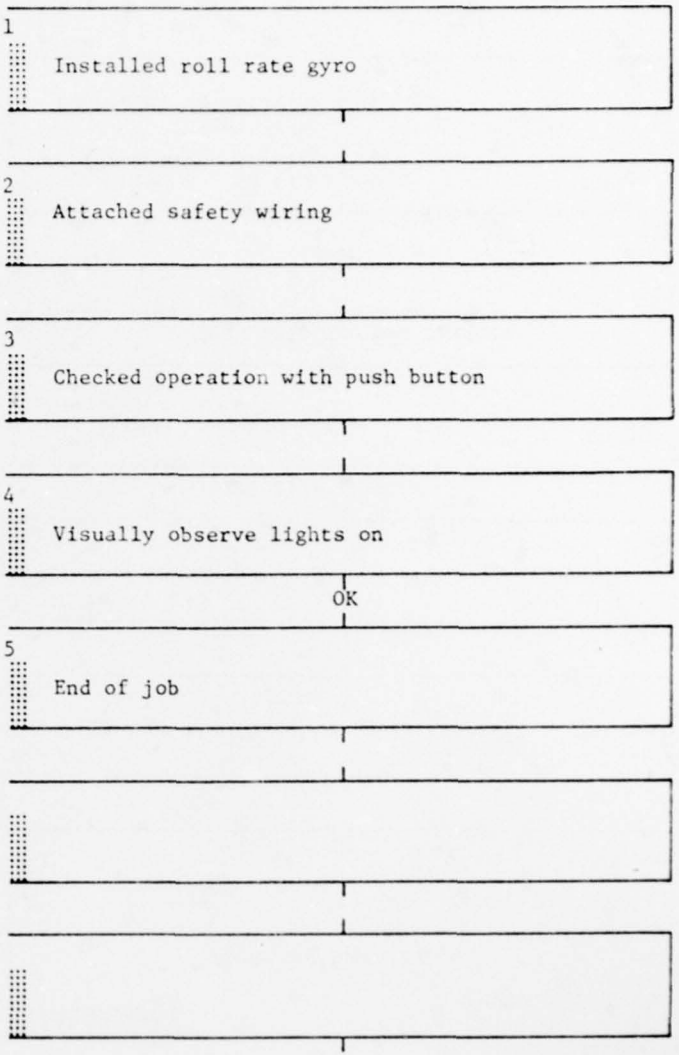
EXPERT COMMENT:

Both evaluators agreed that a gyro speed check on the roll computers should have been done.

AIRCRAFT FOLLOWUP:

No 52A system discrepancy on next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 73 Work Center C Shop System 76K

349 Data

	1	2	3	4	5
JCN	0931080				
TM	B				
WUC	76 KMO				
AT	Q				
WD	F				
HM	799				
Start:	031230				
Stop:	031300				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Action was as indicated. Installation was obvious--only two screws. Any learning had been required on the job.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

Next flight with discrepancy reported 76KMO trouble (4/11).

Activity Sequence

1 Install low band power amplifier

2 End of job
(In-flight ops check)

FIELD OBSERVATION SUMMARY

Rand ID 74 Work Center C Shop System 76M

349 Data

	1	2	3	4	5
JCN	092B122				
TM	B				
WUC	76 MAO				
AT	Q				
WD	F				
HM	799				
Start:	032100				
Stop:	032130				
Skill	3				

NARRATIVE OF MAINTENANCE ACTION:

A very easy installation was required involving a fastener and a few cable connections.

The task was done from memory. Procedures were learned on the job.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No 76M problems on next sortie.

Activity Sequence

1 Install ALR-41

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 75 Work Center A Shop System 73H, 73P

349 Data

	1	2	3	4	5
JCN	0920745	0920746	0920747		
TM	B	B	B		
WUC	73HGO	73HOO	73POO		
AT	R	H	H		
WD	D	D	D		
HM	242	812	799		
Start:	03:1600	03:1705	03:1800		
Stop:	03:1705	03:1800	03:1815		
Skill	5	5	5		

NARRATIVE OF MAINTENANCE ACTION:

Report was of a WDC which failed frequently in flight. Crew reported also no control over sequence point and they were unable to obtain radar lock-on in CCIP mode.

Troubleshooting indicated a failed GNC. Replacement appeared to completely remove all problems.

The tasks were performed via memory of procedures. OJT & FTD were credited in all tasks with having provided useful training.

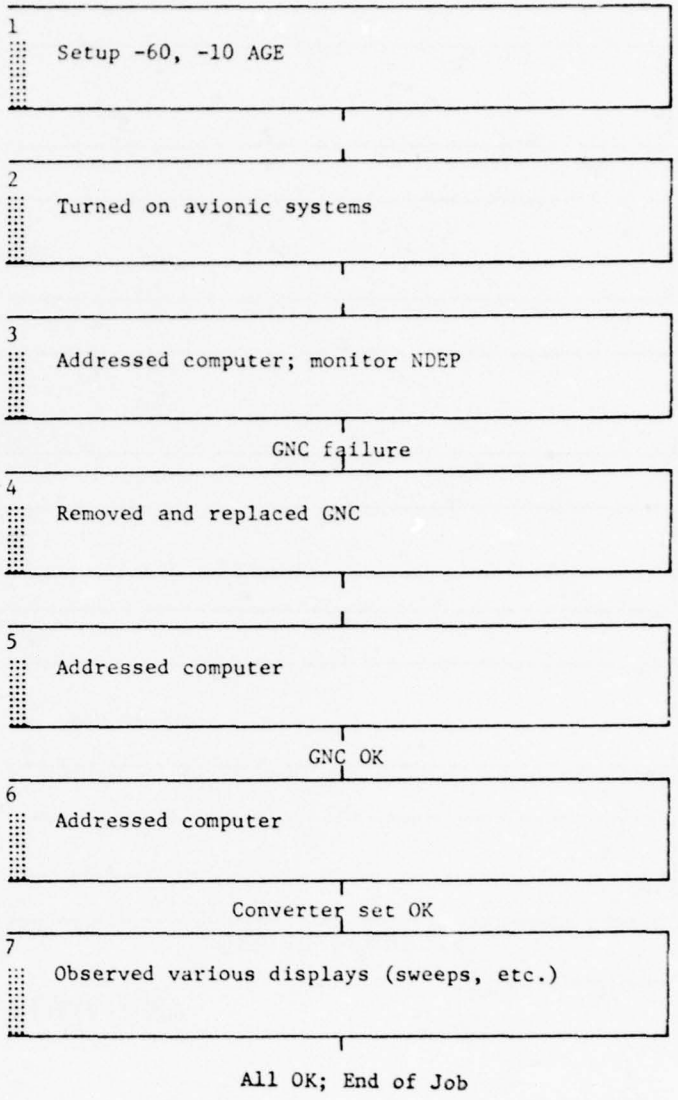
EXPERT COMMENT:

One expert rated this work JSA; the other felt that the MI should have made a specific check of CCIP mode at end of job.

AIRCRAFT FOLLOWUP:

System 73H was bench-checked and repaired. No further action on 73P. Another 73H discrepancy developed on the next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 76 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0930929				
TM	B				
WUC	73HCO				
AT	T				
WD	F				
HM	799				
Start:	03:1815				
Stop:	03:2145				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Cannibalization to obtain a GNC. Task done by memory - learned OJT.

EXPERT COMMENT:

One evaluation was JSA; the other felt that the time required was excessive.

AIRCRAFT FOLLOWUP:

This JCN not listed. There was a 73H system discrepancy on 4/2. Next flight of 96 was on 4/11; no 73H discrepancy report.

Activity Sequence

1 Removed GNC

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 77 Work Center A Shop System 73S & H

349 Data

	1	2	3	4	5
JCN	0801080	0801080			
TM	B	B			
WUC	73S00	73H00			
AT	X	X			
WD	F	F			
HM	799	799			
Start:	03:2005	03:2045			
Stop:	03:2045	03:2200			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

The requirement was to ops check the NDDP and INS. (It had been installed to correct monitor functions; the INS would not come up). The NDDP checked good.

Procedures were followed from memory. They had been learned thru OJT.

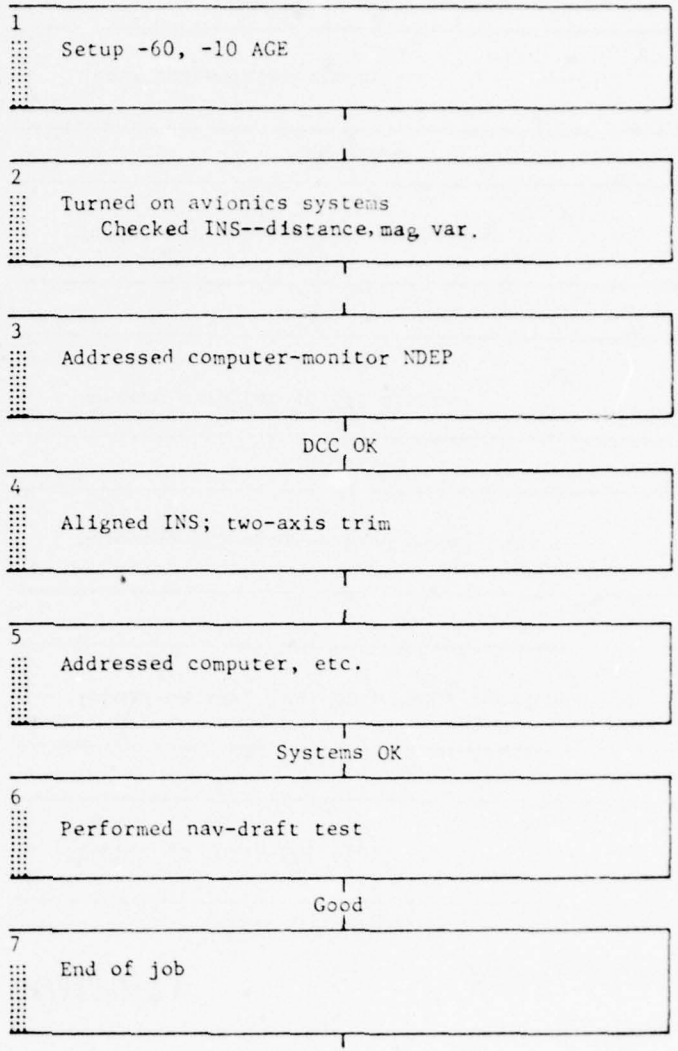
EXPERT COMMENT:

One reviewer commented that the description needed more detail regarding the INS alignment action. The other felt that this was a perfect write-up for the No. 2 job only. (It seems probable that the MM did not fully explain his 73S work.)

AIRCRAFT FOLLOWUP:

No data available from March 21st until first April flight on 4/11. There was a 73H write-up on that sortie, but none on the 73S system.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 79 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0930758				
TM	B				
WUC	73 PDO				
AT	R				
WD	D				
HM	242				
Start:	01				
Stop:	040800				
Skill	041100				

NARRATIVE OF MAINTENANCE ACTION:

This section resulted from a report of intermittent ARS video. The transmitter was replaced.

Tasks 4,5,6 and 9 were done while consulting a tech order. Other tasks were done from memory.

The FTD was helpful in learning how to turn on equipments (task 1) but OJT provided the know-how for the other tasks.

EXPERT COMMENT:

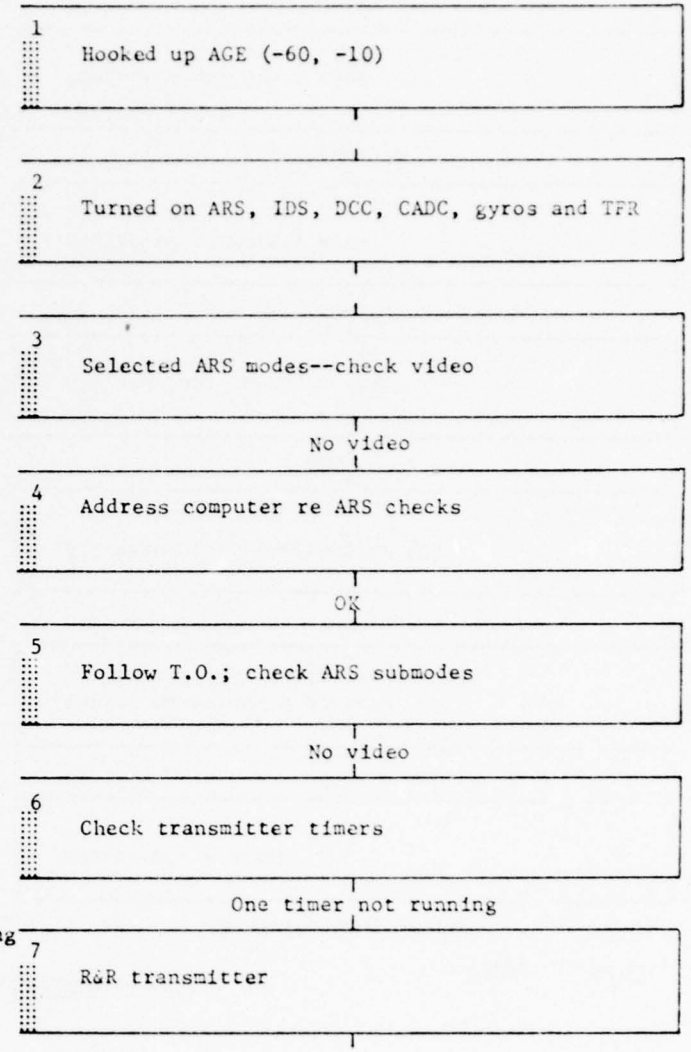
Both JSA, though more detail re MCU, ATP, and computer addressing would be useful in job evaluation.

AIRCRAFT FOLLOWUP:

TS found no-go indicator and repaired unit. (Completed repair on 4/22.)

The system was checked again after the next flight following a write-up but no defect was found.

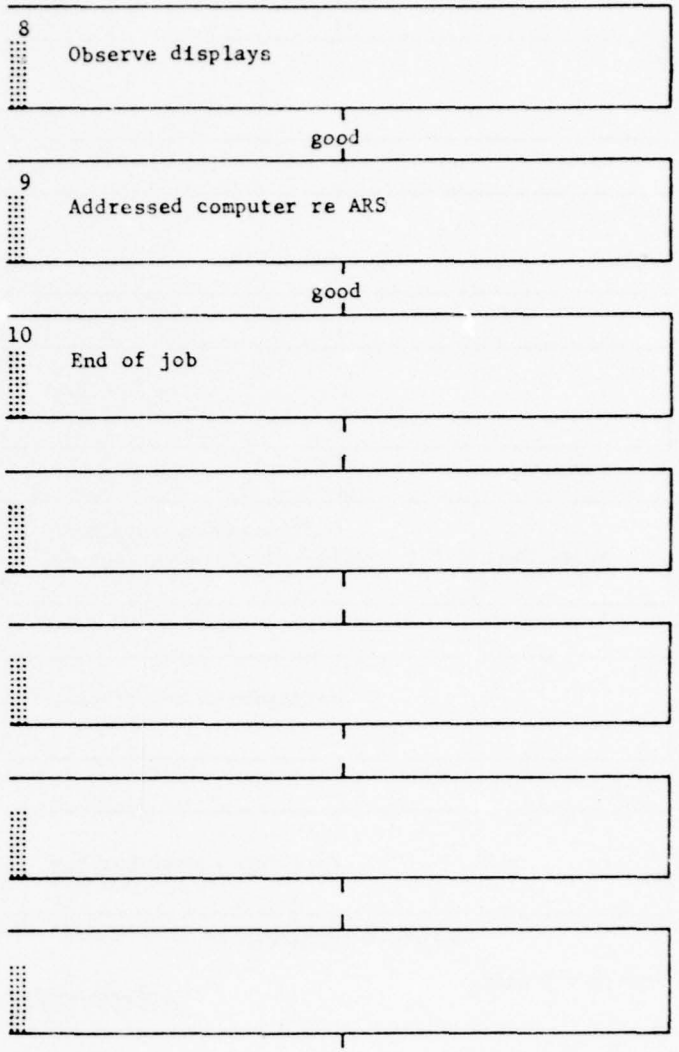
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 79 Work Center A Shop System 73P

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 80 Work Center C Shop System 61A

349 Data

	1	2	3	4	5
JCN	0940851				
TM	B				
WUC	61 ABO				
AT	Q				
WD	D				
HM	799				
Start:	07:0800				
Stop:	07:0915				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

The power amplifier for the HF radio had been previously removed. This action involved its installation. While the installation procedure is simple, knowledge regarding such tasks was gained in FTD and OJT.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No 61A problem next flight

Activity Sequence

1 AGE required (-60, -10)

2 Install power amplifier

3 Weather bad--no ops check. (Lightning makes operation dangerous).

4 End of job

FIELD OBSERVATION SUMMARY

Rand ID 83 Work Center RR System 73H

349 Data

	1	2	3	4	5
JCN	0940664				
TM	B				
WUC	73HCO				
AT	R				
WD	B				
HM	242				
Start:	04:1000				
Stop:	04:1055				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The INS was reported caged. The Roadrunner A Shop maintenance man attempted to solve this problem prior to launch but failed. Crew decided to fly with INS problem.

The MM relied on his memory of procedures in all but task 13 where he followed the T.O.

The learning required here was from OJT, including working with the Tech. Orders. FTD was indicated as helpful in Tasks 2, 3 and 5.

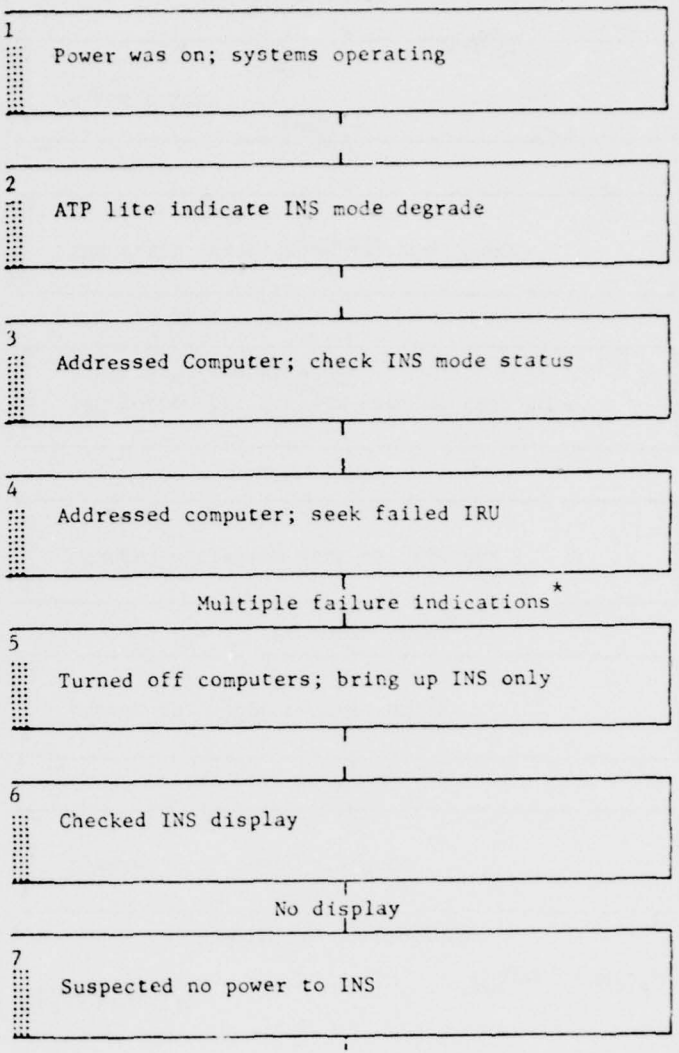
EXPERT COMMENT:

One felt that the MM should have recycled INS after initial INS caged indication. NCU a good guess for R&R (even though it did not solve this problem). The other expert rated the job as satisfactorily accomplished.

AIRCRAFT FOLLOWUP:

TS bench checked and repaired. "How mal" was "data error." Trouble in same system next two flights.

Activity Sequence

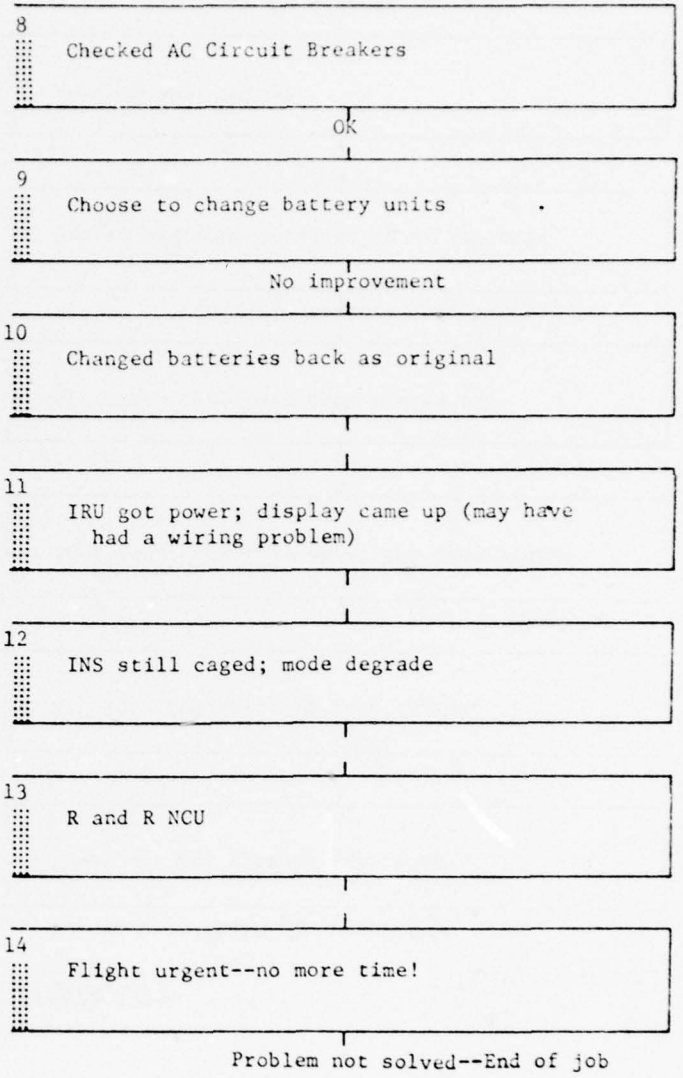


*NCU memory scramble

FIELD OBSERVATION SUMMARY

Rand ID 83 Work Center RR System 73H

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 85 Work Center RR System 630

349 Data

	1	2	3	4	5
JCN	0940442				
TM	B				
WUC	63 000				
AT	Y				
WD	B				
HM	242				
Start:	04 1020				
Stop:	04 1055				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

A Roadrunner job--this was a repeated discrepancy--an inoperative UHF.

The job was performed from memory, however, the cover of the UHF provides checking information.

All procedures were learned via OJT.

EXPERT COMMENT:

1st--JSA.

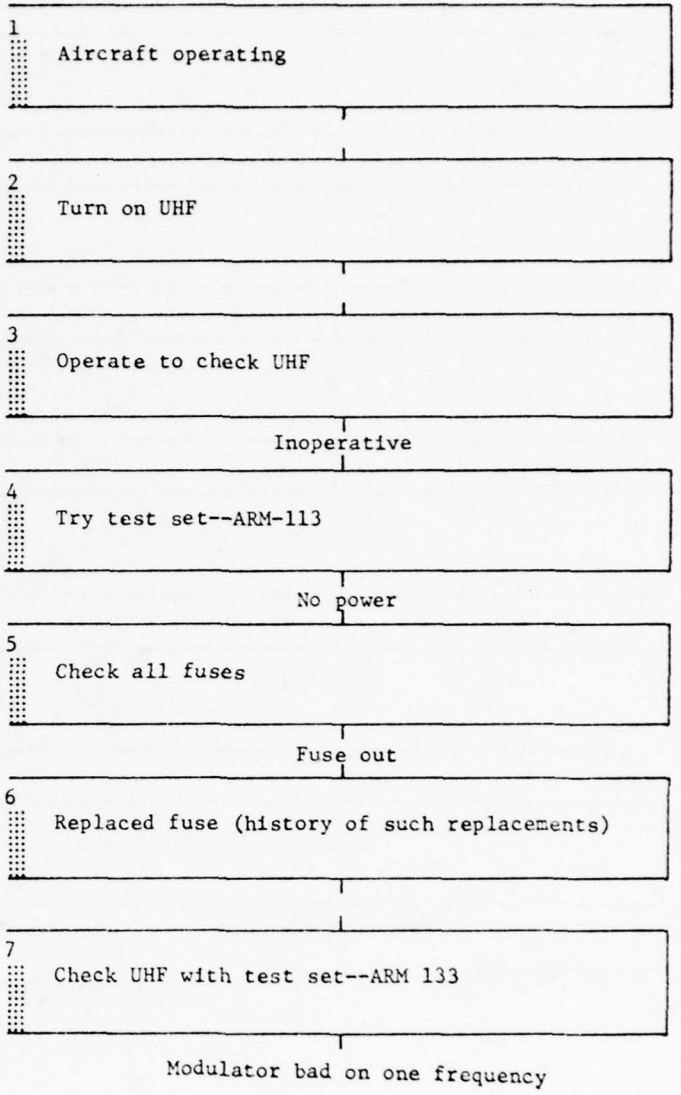
2nd--Surprised at use of test set.

AIRCRAFT FOLLOWUP:

JCN not listed.

No repeat on sorties of 4/13 (First April sortie listed in Debrief--AFTO 349 Reconciliation Report).

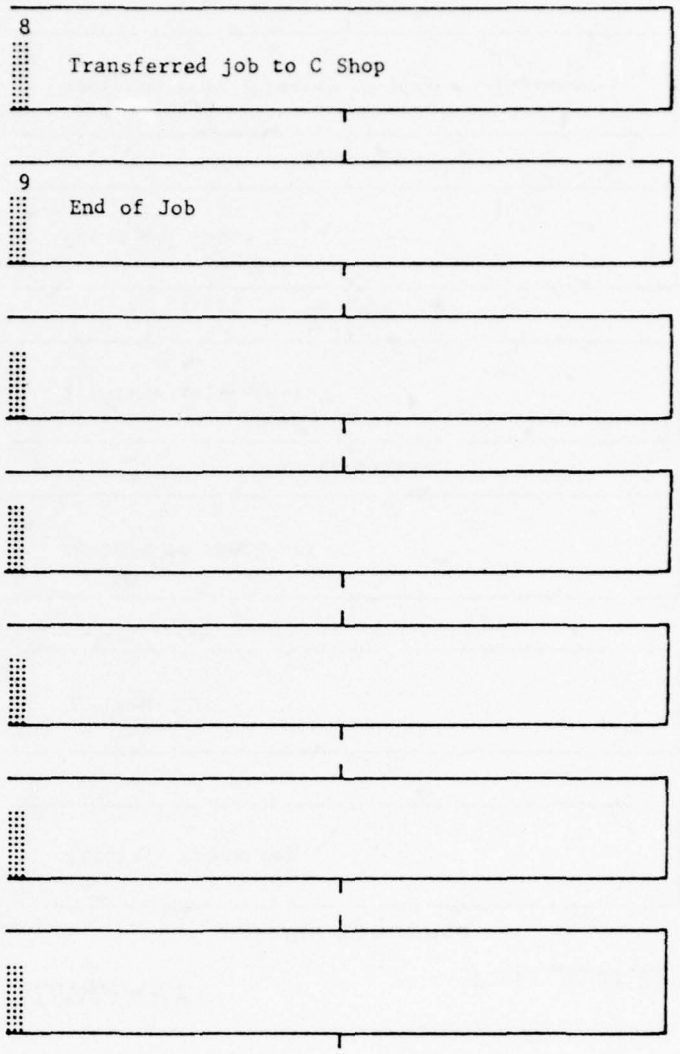
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 85 Work Center RR System 630

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 87 Work Center RR System 73P

349 Data

	1	2	3	4	5
JCN	0940663				
TM	B				
WUC	73 PMO				
AT	R				
WD	B				
HM	242				
Start:	041000				
Stop:	041015				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Roadrunner was called to assist this aircraft which was preparing to launch. The R crew found problems re ARS ranging error and strobing on the MSD. The octal output after addressing the computer (drawing numerical codes from memory) indicated either a bad master frequency generator (MFG) or bad microwave receiver unit (MRU). The MM felt that there was still a "small possibility" that the trouble was in the IDS but a visual check of the displays proved this was not the case. Therefore, he proceeded to R&R the MFG. A check of the ARS displays showed improvement including decreasing strobing. The MM would have sought further improvement by next removing and replacing the MRU, but the pilot decided to launch rather than wait for further maintenance.

The maintenance tasks were done by memory. Only about 15 minutes were expended by the Roadrunner man in performing these tasks.

All learning of tasks procedures (including decision processes) had been learned in OJT.

Activity Sequence

1. Aircraft operating, power on

2. Take-off checks of ARS from Tech. Order

ARS ranging error; strobing on MSD

3. Addressed computer

DCC and ARS OK; suspects MFG or MRU

4. Check IDS; set switches, observe displays (MSD, STU good)

OK

5. R&R MFG

6. Check via visual evaluation of ARS displays

Improved

7. (No time to R&R MRU; pilot chose to launch)

FIELD OBSERVATION SUMMARY

Rand ID 87 Work Center RR System 73P

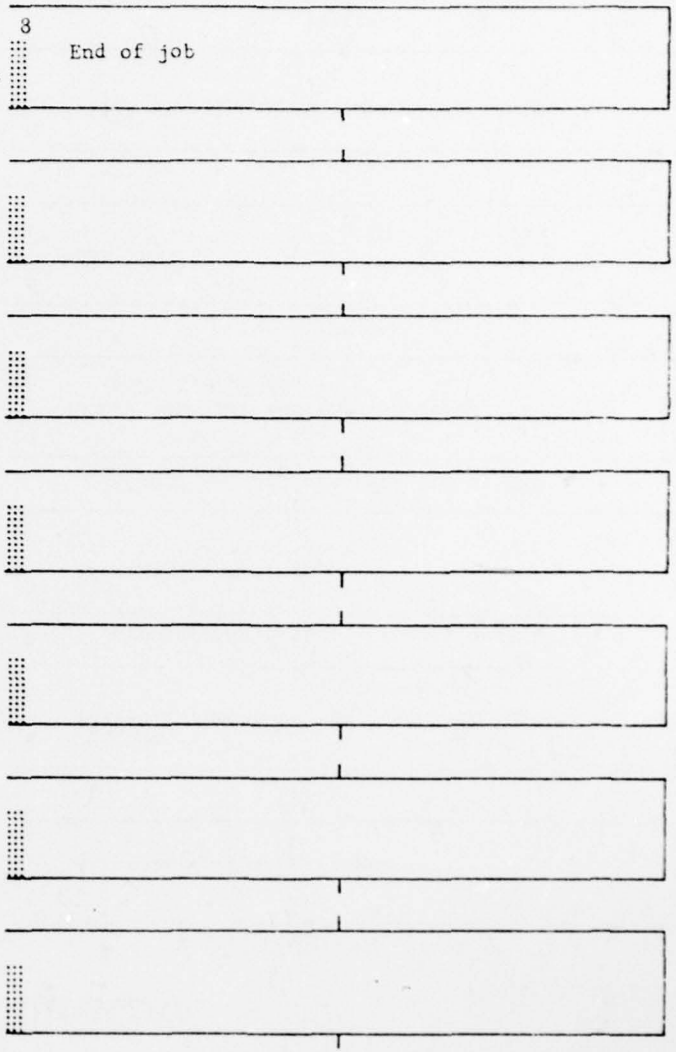
EXPERT COMMENT:

Ranging error could only be EPU--R&R of EPU could have eliminated MRU problem. Checking IDS is a good procedure.

AIRCRAFT FOLLOWUP:

TS bench-checked and repaired this unit. No problem next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 88 Work Center RR System 52B

349 Data

	1	2	3	4	5
JCN	0940668				
TM	B				
WUC	52 BBR				
AT	R				
WD	B				
HM	242				
Start:	04:1335				
Stop:	04:1355				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Crew, awaiting launch, reported a constant CADS lite to the Roadrunner team.

The tasks were performed by memory of procedures; Tech. School taught about the self-tests; tasks 2 and 6. Other tasks were learned by experience on-the-job and OJT.

EXPERT COMMENT

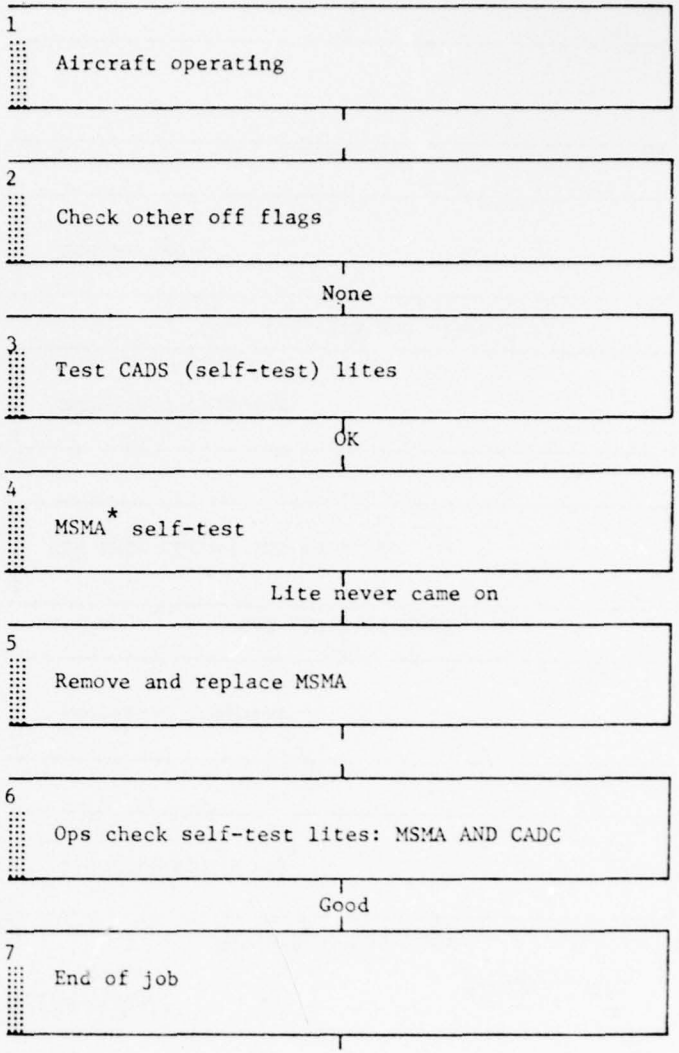
JSA

AIRCRAFT FOLLOWUP:

This JCN is not listed in discrepancy reports. Record shows take-off time as 09:27! Next sortie was on 4/8. No 52B actions listed re either flight.

*MSMA: Maximum Safe Mach. Assembly

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 89 Work Center RR System 73H

349 Data

	1	2	3	4	5
JCN	0940669				
TM	B				
WUC	73HAO				
AT	R				
WD	B				
HM	242				
Start:	04:1345				
Stop:	04:1405				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report to Roadrunner of INS caged. Solved by replacement of Inertial Reference Unit.

Job was performed by memory of procedures learned through OJT.

EXPERT COMMENT:

The MM should have recycled INS before R&R of the IRU; 3 out of 5 times this will solve problem. A second opinion was JSA.

AIRCRAFT FOLLOWUP:

This sortie was not listed. No discrepancy this system on next sortie.

Activity Sequence

1 Aircraft operating

2 Addressed computer

Bad IRU indicated

3 R&R IRU; turned INS back on

4 Addressed computer

Good (Uncaged and aligned OK)

5 End of job

FIELD OBSERVATION SUMMARY

Rand ID 90 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	094850				
TM	B				
WUC	73RCO				
AT	R				
WD	D				
HM	242				
Start:	04:1400				
Stop:	04:1455				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This was a Roadrunner action. The ARS was reported to have weak video and show no range marks.

MM started R&R actions on several LRUs. Finally replacing the STU helped to some degree. No further work was done due to urgency of launch.

The applicable T.O. was used as remembered and all tasks were learned via OJT.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

This JCN record is missing from the discrepancy listing. Flight on 4/11 had no 73R write-ups.

Activity Sequence

1. Aircraft operating - power on

2. Address computer

ARS OK

3. Check ARS video (visually)

Weak video

4. R&R EPU - check video

No improvement

5. Replace original EPU

6. R&R STU

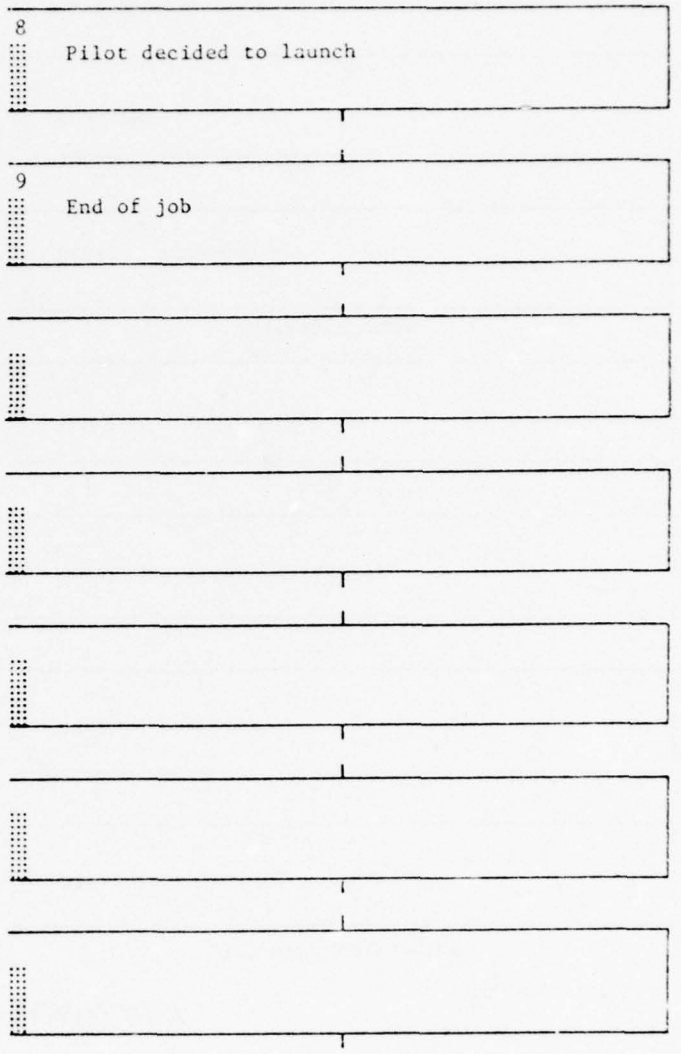
7. Check ARS video

Good--but now ranging bad

FIELD OBSERVATION SUMMARY

Rand ID 90 Work Center A Shop System 73R

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 91 Work Center RR System 61A

349 Data

	1	2	3	4	5
JCN	0940851				
TM	B				
WUC	61 AAO				
AT	R				
WD	D				
HM	242				
Start:	04:1400				
Stop:	04:1455				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The HF radio was reported as inoperative to Roadrunner. While the BITE indicated an operative transmitter, it was decided to replace it. This resulted in some improvement but not a good system. The pilot decided to launch without further troubleshooting.

The MM used a Tech. Order to operate the BITE but relied on his memory regarding R&R.

The BITE was discussed in FTD training. All other tasks here were learned via OJT.

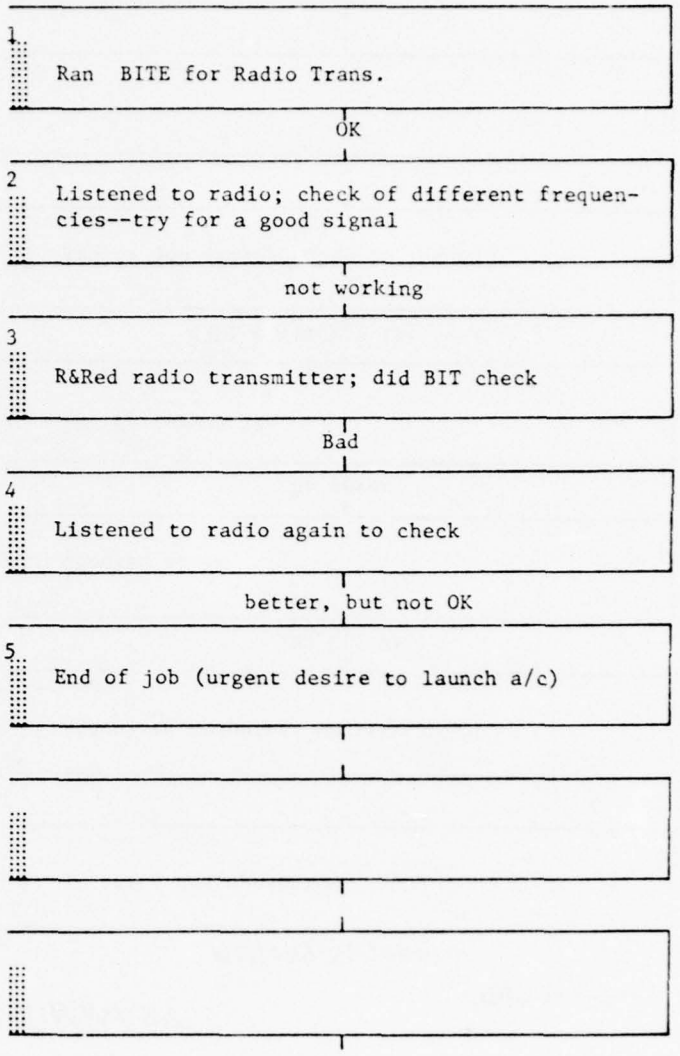
EXPERT COMMENT:

First: trouble could be XMTR, PA, or Coupler Control. XMTR and PA easy to get to; RR urgency would prevent control work. Basically JSA. Second: JSA.

AIRCRAFT FOLLOWUP:

A Shop R&Red the 61AAO unit again the next day and the TS repaired it. No discrepancy report next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 92 Work Center RR System 73H

349 Data

	1	2	3	4	5
JCN	0940672				
TM	B				
WUC	73HDO				
AT	R				
WD	B				
HM	242				
Start:	04:1445				
Stop:	04:1455				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The Roadrunner MM attempted to bring up the INS (which would not align) by replacing the battery unit (after concluding that a low power condition existed). Some improvement resulted--further work not possible due to pilot's decision to launch.

The MM had a memory of TO instructions. All knowledge regarding the tasks listed was acquired through OJT.

EXPERT COMMENT:

One JSA; the other questioned meaning of "INS partially improved."

AIRCRAFT FOLLOWUP:

TS followed this RR action with a bench check and repair (how mal was "incorrect voltage" (169)). A system action was required after the next sortie--an adjustment on LRU 73HGO.

Activity Sequence

1 Aircraft was operating

2 Addressed computer; monitor NDEP

INS not up

3 Checked clock

No power

4 R&R Battery Unit

INS partially improved

5 End of job (Pilot chose to launch)

FIELD OBSERVATION SUMMARY

Rand ID 93 Work Center RR System 52A

349 Data

	1	2	3	4	5
JCN	0940673				
TM	B				
WUC	52 AAA				
AT	L				
WD	B				
HM	127				
Start:	04:1430				
Stop:	04:1440				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

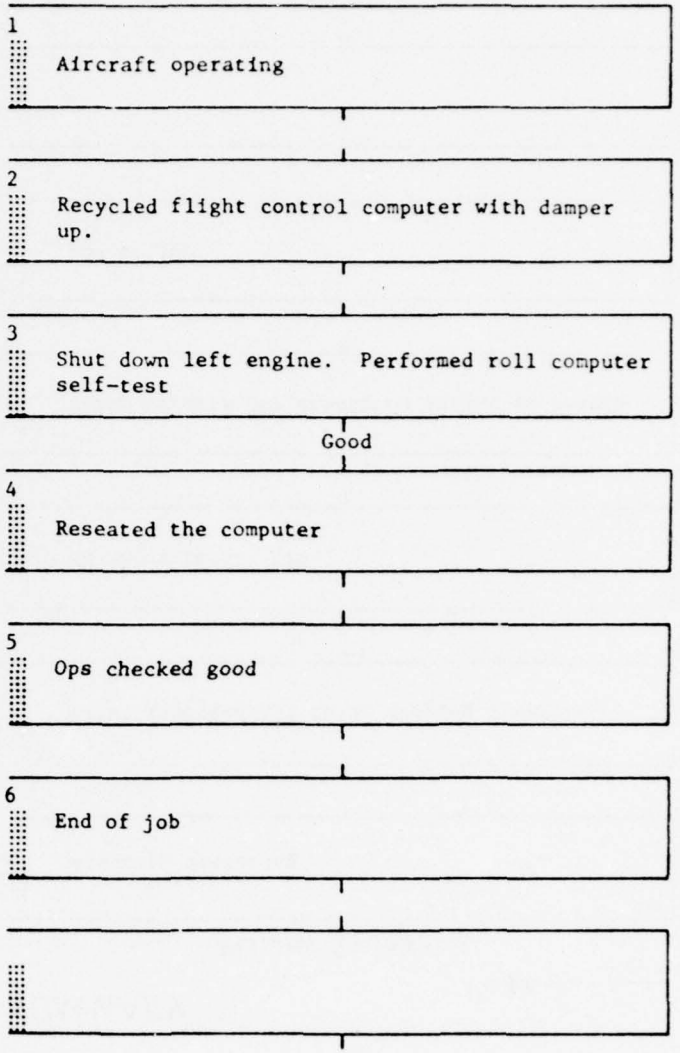
Autopilot trouble was reported to RR in the roll control damper. Reseating the unit solved the problem.

MM worked from memory. He credited OJT as his source of learning this job.

AIRCRAFT FOLLOWUP:

No repeat next flight

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 94 Work Center RR System 73P

349 Data

	1	2	3	4	5
JCN	0940670				
TM	B				
WUC	73 PBO				
AT	R				
WD	B				
HM	242				
Start:	041410				
Stop:	041425				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Pilot reported this ARS discrepancy to the Roadrunner crew. The MM, under great time urgency, used his best judgment, gained from OJT, and changed EPUs. The pilot then reported an OK and that he intended to launch immediately.

The maintenance tasks were done from memory. The knowledge used was acquired while on the job.

EXPERT COMMENT:

First: Good procedure--but EPU only appropriate LRU--no guess.

Second: Good procedure when time is critical (as for RR).

AIRCRAFT FOLLOWUP:

No record of this RR action. Aircraft launch is listed as occurring at 1425, however, and no discrepancy in the 73P system appeared after flight.

Activity Sequence

1. Aircraft operating
2. Pilot reported ARS radar ranging incorrect
3. MM chose to R&R EPU
4. Pilot reports OK; announces intent to launch
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 95 Work Center B Shop System 14A

349 Data

	1	2	3	4	5
JCN	2901111				
TM	B				
WUC	14 AFB				
AT	X				
WD	F				
HM	799				
Start:	07:1200				
Stop:	07:1300				
Skill	5,5,5				

NARRATIVE OF MAINTENANCE ACTION:

It was necessary to check the Yaw Variable Feel Control Valve.

The T. O. was used extensively but OJT was also needed to be efficient in this job.

Tech. School has acquainted MM with autopilot switch settings but lacked an aircraft to provide the best understanding.

EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

No data on aircraft 8112.

Activity Sequence

1. Hooked up -60 and mule (AGE)
2. Check via T. O. operation of Yaw Variable Feel Control Valve
3. Operate autopilot configurations; Take-Off, Landing; and Normal
4. Observe rudder authority light while pushing rudder pedal

   Lites OK; pedal feel is good
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 96 Work Center B Shop System 46A

349 Data

	1	2	3	4	5
JCN	0970414				
TM	B				
WUC	46 AAO				
AT	X				
WD	F				
HM	799				
Start:	07:1350				
Stop:	07:1420				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

The crew chief reported a fuel quantity indicator problem. The maintenance men determined that the reading was within tolerance.

The T.O. gave the subsystem tolerances; the knowledge of its use had been acquired in Tech. School.

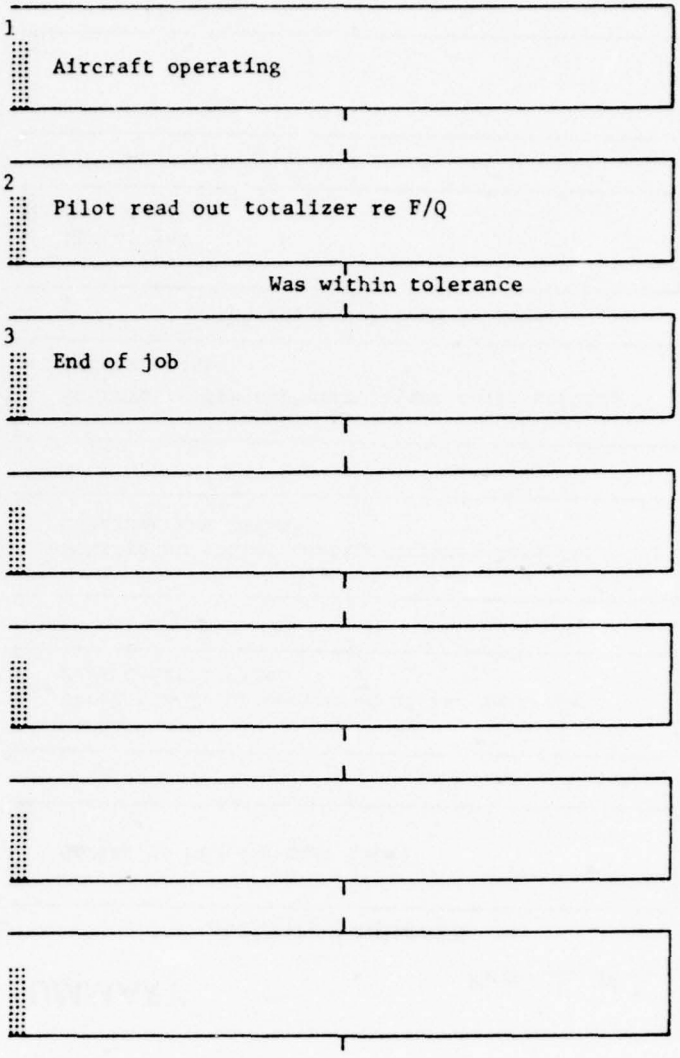
EXPERT COMMENT:

MM should have also used the self-test.

AIRCRAFT FOLLOWUP:

No 46A trouble listed in April--no record of this JCN.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 97 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0970666				
TM	B				
WUC	52 AAA				
AT	R				
WD	B				
HM	374				
Start:	07:1405				
Stop:	07:1500				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Problem consisted of a non-resetable roll channel lite. After ops check, the roll computer was replaced and the problem solved.

The procedures in ops checking were drawn from memory--job had been done many times before.

All pertinent training--this job--was via OJT.

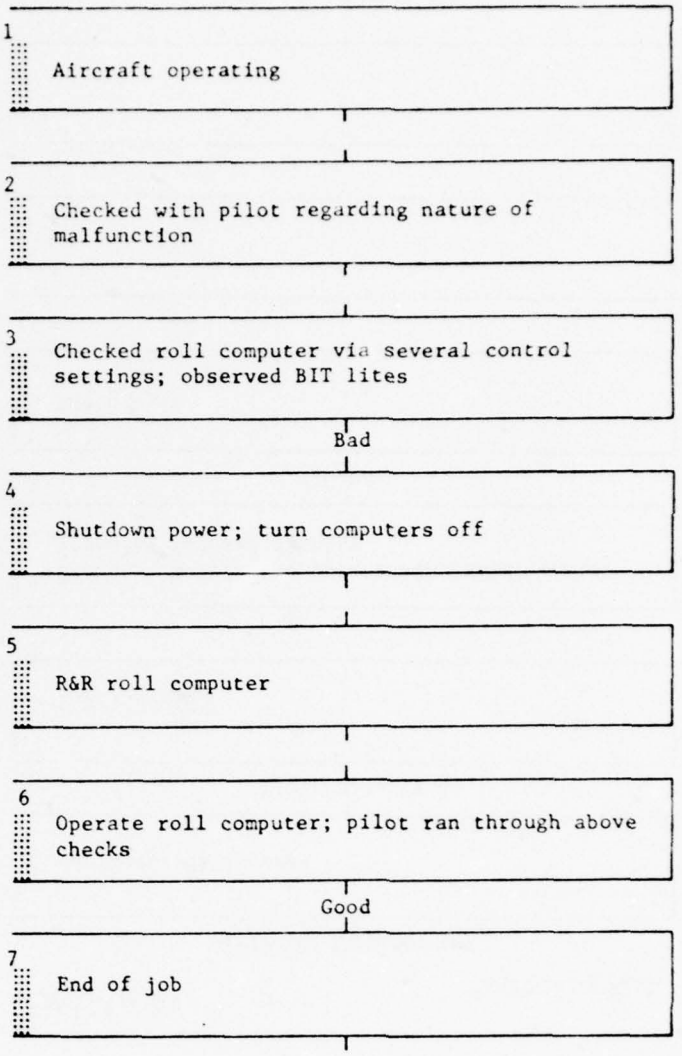
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

Aircraft take-off time is listed as 14:20. No record of maintenance actions before 19:30. System 52A discrepancy next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 98 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0980456				
TM	B				
WUC	52 BCA				
AT	R				
WD	F				
HM	080				
Start:	08:0730				
Stop:	08:0900				
Skill	3,5				

NARRATIVE OF MAINTENANCE ACTION:

The Angle-of-Attack Indicator Light was defective. It was removed and replaced.

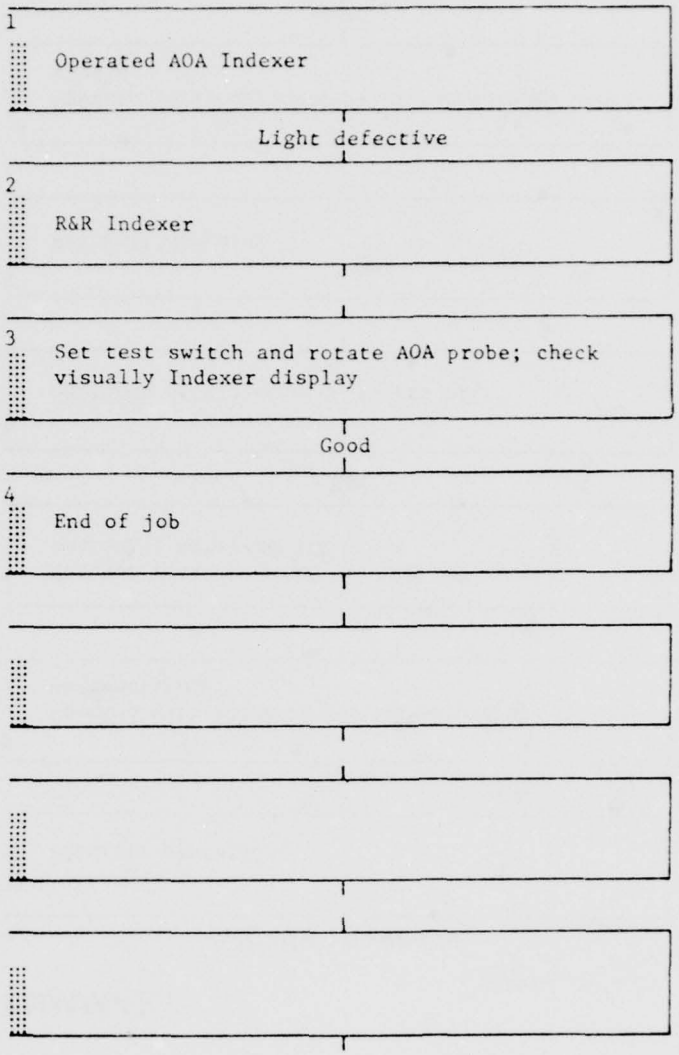
All tasks were performed according to memory of task operations.

The MM recalls learning about the AOA Indexes in Tech. School because he asked for such information. Tasks 2 and 3 were learned in OJT.

AIRCRAFT FOLLOWUP:

Take-off time was 11:08. No 52B system problems after next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 99 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0940666				
TM	B				
WUC	73SBO				
AT	Q				
WD	F				
HM	799				
Start:	08:1700				
Stop:	08:2000				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Required action was to install the right DCU. Several panel removals were necessary in order to connect to the Cannon plug.

Task operations were performed according to memory of the job.

The Technical School had only an FB-111A model to work on and it is very different from the F-111D model. Technical orders are essential and allow one to learn a job through personal effort. All tasks here were learned on the job.

EXPERT COMMENT:

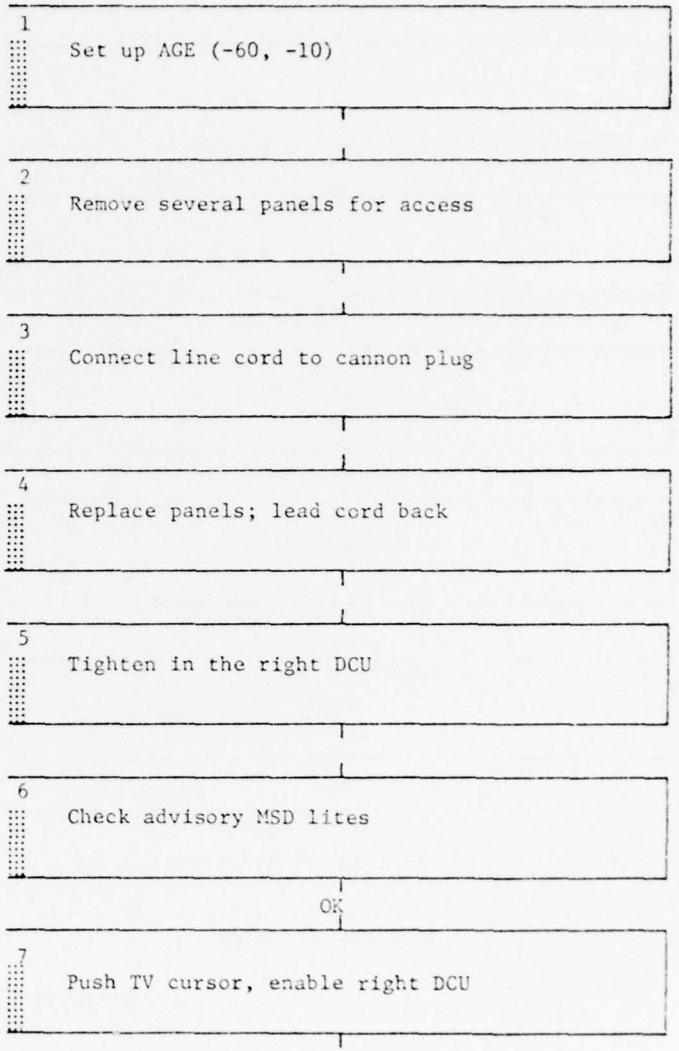
First--The checking of MSD advisory lights was unnecessary. The MM should have:

1. Checked designator button for proper operation
2. Checked freeze for proper operation
3. Power up attack radar and check antenna tilt knob.

Second--MM should:

1. Do freeze display on scopes
2. Do "lock up" to target

Activity Sequence



FIELD OBSERVATION SUMMARY

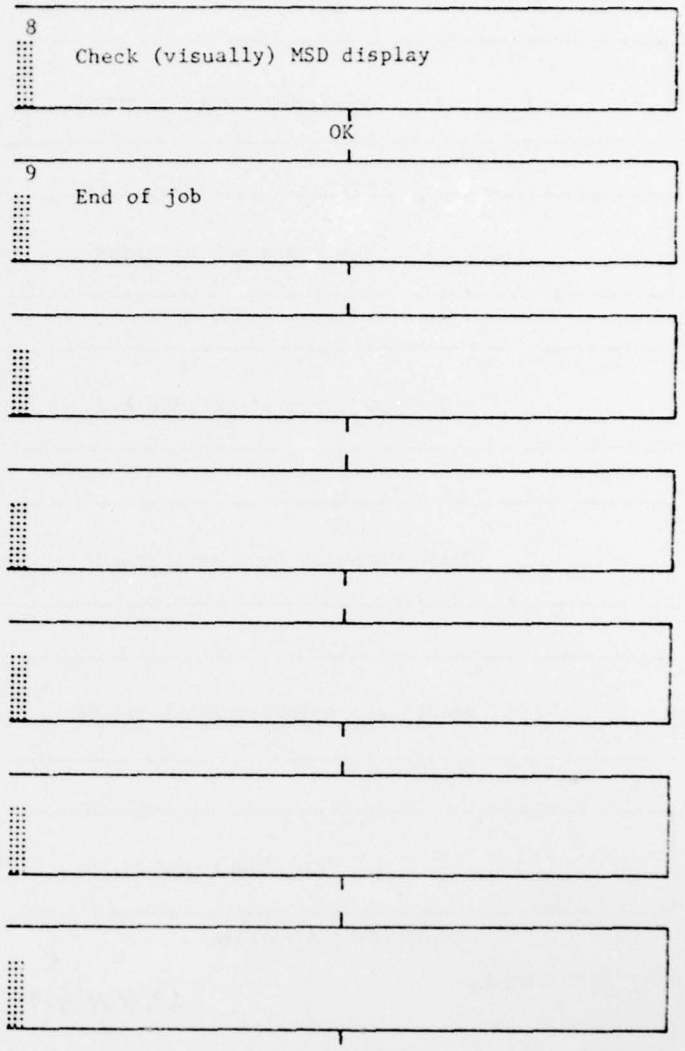
Rand ID 99 Work Center A Shop System 73S

NARRATIVE OF MAINTENANCE ACTION: (continued)

AIRCRAFT FOLLOWUP:

This JCN is not listed in discrepancy listing. Sortie on 4/9 had no 73S write-up.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 100 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0970751				
TM	B				
WUC	73 PBO				
AT	R				
WD	D				
HM	242				
Start:	07 2000				
Stop:	07 2305				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The ARS was reported to produce ranging errors in the air-to-air mode. The MM found the system to be out of tolerance and the EPU to be defective. He removed and replaced the EPU.

The tasks of this job were performed according to memory of the correct procedures.

This MM had learned how to turn the avionics systems on in FTD; ops checks and R&R were learned via OJT.

EXPERT COMMENT:

First: Did not need to address computer; only A/A self-test necessary.

Second expert: Could have done a more thorough job.

AIRCRAFT FOLLOWUP:

TS adjusted this LRU following its removal (How mal = 127).

Repeat writeup next flight led to another R&R. No write-ups this system next 10 sorties.

Activity Sequence

1. Hooked up AGE (-60, -10, Lightall)
2. Turned systems on
3. Addressed computer: (octal status readout)

EPU bad

4. Observed ATP Failure Status Lamps

RDR lite supports EPU bad possibility

5. Performed A/A ranging checks

out of tolerance

6. R&R EPU
7. Observed ATP lites and addressed computer; also performed A/A ranging check

checks good; End of job

FIELD OBSERVATION SUMMARY

Rand ID 101 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0970753				
TM	B				
WUC	73 P00				
AT	H				
WD	D				
HM	812				
Start:	07:2305				
Stop:	07:2355				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The task was to check the CCIP on the aircraft worked on just previously. The same MM checked this (can't do a full simulation of the ground) during his previous ops check and the display looked good. He then assumed that replacement of the EPU, just completed, had solved the problem. (Can't be sure until next flight of this aircraft.)

The checking of the CCIP was performed from memory. It was originally learned through OJT.

EXPERT COMMENT:

One said JSA; the other felt that the subsystem tie-in test set (12A 6659) could have been used to provide a more complete simulation.

AIRCRAFT FOLLOWUP:

No repeat of this CCIP discrepancy (the 73P write-up on next flight was in reference to A/A ranging (see #100)).

Activity Sequence

1 Check the CCIP via partial flight simulation

Good, but not a full sim.

2 End (see narrative)

FIELD OBSERVATION SUMMARY

Rand ID 102 Work Center C Shop System 63A

349 Data

	1	2	3	4	5
JCN	0970733				
TM	B				
WUC	63 ABO				
AT	R				
WD	D				
HM	070				
Start:	08:1700				
Stop:	08:1850				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Tone button on UHF had broken off. The UHF control box was therefore removed and replaced.

The tasks were done according to memory.

The operating procedures and other knowledge of this equipment had been obtained from the FTD.

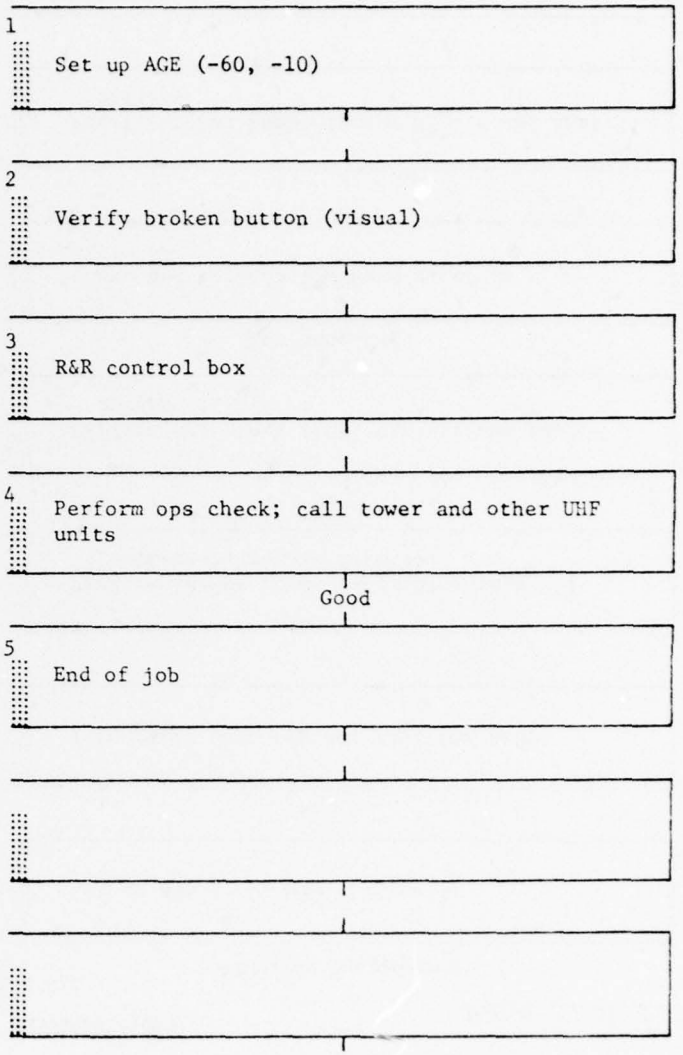
EXPERTS COMMENTS:

First: JSA. Second: Should have used test set at step 4.

AIRCRAFT FOLLOWUP:

No further shop or TS actions listed. No 63A reports next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 103 Work Center C Shop System 76D, K, L; also 61A

349 Data

	1	2	3	4	5
JCN	0980711	0980709	0980712	0980708	
TM	B	B	B	B	
WUC	76L00	61AC0	76KK0	76D00	
AT	X	P	R	X	
WD	D	D	D	D	
HM	799	070	290	602	
Start:	08:1900	08:1930	08:2000	08:2030	
Stop:	08:1930	08:2000	08:2030	08:2100	
Skill	5,5	5,5	5,5	5,5	

NARRATIVE OF MAINTENANCE ACTION:

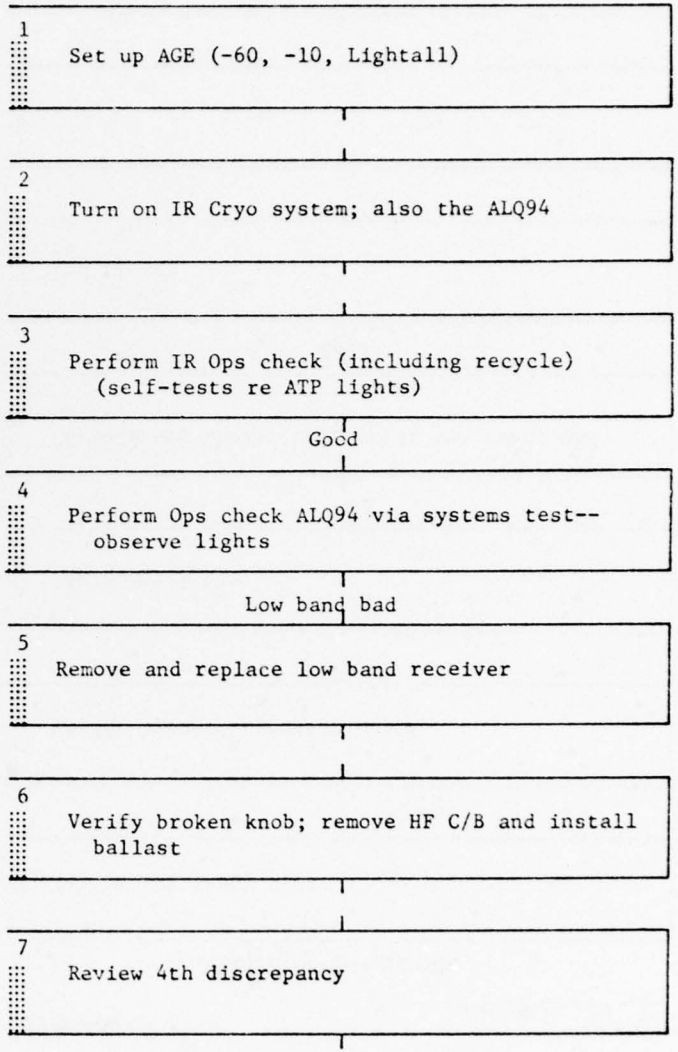
There were four discrepancies written relating to aircraft 163. These were (1) the IR Cryo fail lite came on; (2) a knob was broken on the HF control box, (3) the ALQ-94 has flashing receiver and power amplifier lights; and (4) the OMNI display of the APS109 was out of tolerance.

The corrective actions were as follows: (1) recycled in Cryo system; (2) replaced the HF control box; (3) removed and replaced the low band receiver; and (4) could not TS as DAU was out of aircraft.

The MM performed all tasks accoridng to his memory of proper procedures.

OJT was the source of skills associated with all remove and replace actions, operating the IR cryo system, and determining how to deal with the 4th discrepancy. The op checks had been learned in FTD (which this MM had had at Nellis AFB).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 103 **Work Center** C Shop **System** 76D, K, L; also 61A

NARRATIVE OF MAINTENANCE ACTION (continued):

This MM had some college training in physics. He had started to major in electronics. He felt Keesler Technical School was not pertinent to the F-111D maintenance job.

EXPERT'S COMMENTS:

First--Average MM needs T.O. for best job.

Second expert--JSA.

AIRCRAFT FOLLOWUP:

1. System 76L was not worked on any later April flights.
2. 61ACO (HFC1B) was repaired by the TS and reinstalled by C Shop on 4/9. The aircraft did not report a discrepancy against 61s for their next sortie.
3. TS found 76KKO faulty. No problems next flight.
4. Problems in 76D appeared again two sorties later.

Activity Sequence

8 Could not T/S APS 109 (76D00) as DAU had been removed

FIELD OBSERVATION SUMMARY

Rand ID 104 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0940712				
TM	B				
WUC	73HCO				
AT	Q				
WD	D				
HM	799				
Start:	08:1900				
Stop:	08:2145				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Aircraft was missing an NCU. It was installed and ops checked good.

The MM always followed the T.O. closely the first few times but now perform this task from memory.

The training for these tasks came from OJT.

EXPERT COMMENT:

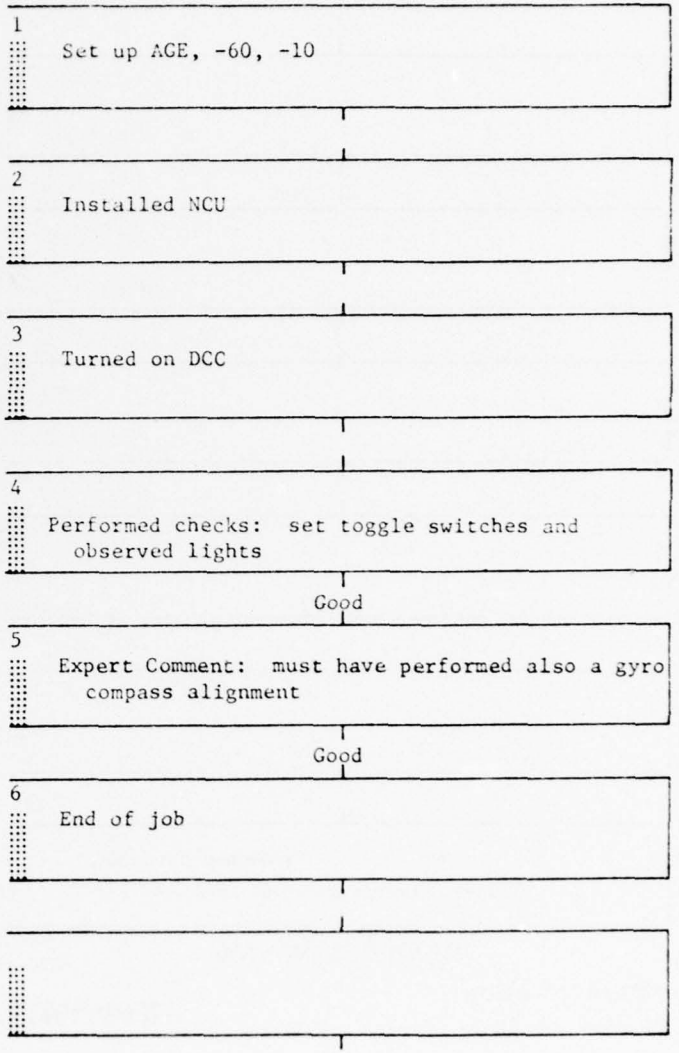
First expert: MM should have monitored the compass during the gyro compass alignment.

Second expert: Ops check detail lacking; MM had to do a 2-axis trim and alignment. The time used suggests they did these things but neglected their mention.

AIRCRAFT FOLLOWUP:

The A-shop day shift had removed an NCU four days after sortie 22, which generated this discrepancy. The T.S. bench checked and reapired the NCU. The 73H system produced no discrepancy on sortie 23.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 105 Work Center 24360 System 73H,K,S+C

349 Data

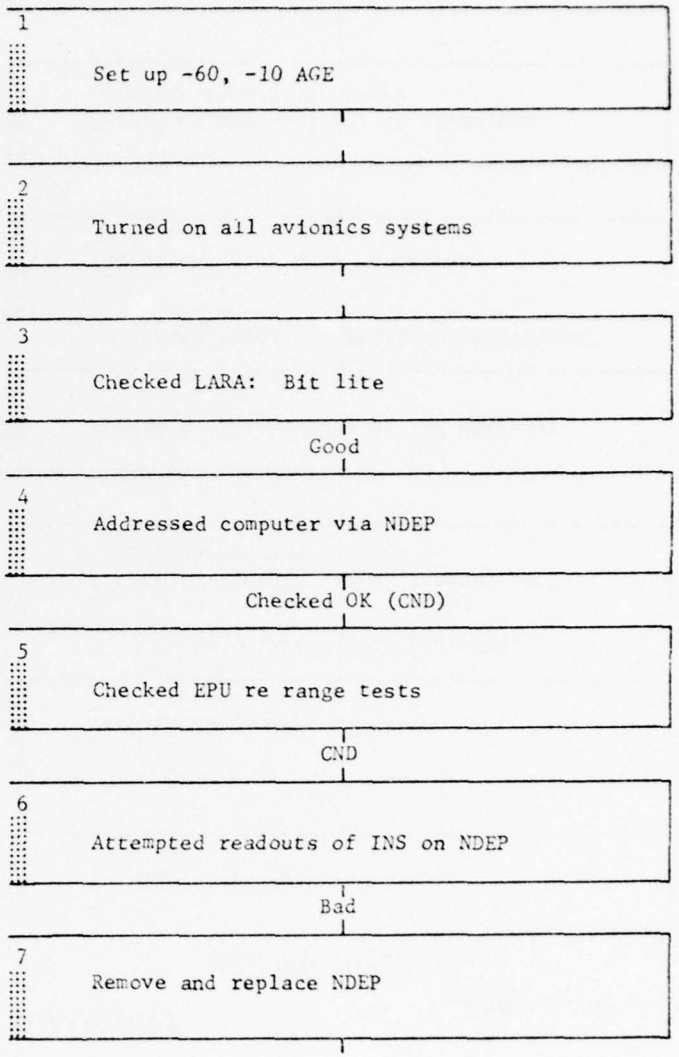
	1	2	3	4	5
JCN	0980754	0980749	0980752	0980751	0980753
TM	B	B	B	B	B
WUC	73 KBO	73 HOO	73 HPO	73 SDO	73 CAP
AT	R	L	L	R	H
WD	D	D	D	D	D
HM	242	127	127	242	799
Start:	08:1900	08:1600	08:1800	08:1700	08:2000
Stop:	08:2000	08:1700	08:1900	08:1800	08:2100
Skill	5	5	5	5	5

NARRATIVE OF MAINTENANCE ACTION:

The discrepancies reported were:

1. Erratic video in both TFR channels
2. Excessive drift in the INS
3. The EPU fails the range test
4. Could not monitor the NDEP
5. Problems with LARA

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 105 Work Center 24360 System 73H,K,S+C

NARRATIVE OF MAINTENANCE ACTION (Cont.):

The second, third, and fifth systems checked OK , i.e., CND. For the fourth the NDEP was removed and replaced. The TFR channels were retuned and the left antenna replaced.

The Technical Order procedure was followed closely in tasks 5 and 10; and it was referred to during tasks 9 and 11. Other tasks were done from memory.

The performance of these tasks had been learned almost entirely from MISD training, with some help from OJT, and none from technical school or FTD.

EXPERT COMMENT:

Should also check Test Altitude on LARA: also check BIT on NDEP.

AIRCRAFT FOLLOWUP:

1st Action (73K): Several TS actions were completed, the last being Bench Check Serviceable with 799 (no defect). A 73K discrepancy write-up on next flight produced no 349 data.

2nd & 3rd Actions (73H): Each action taken code indicated adjustments, but MM says all were CND. Next sortie 73H write-up became a WUC 51E99 action.

4th Action: TS found "no defect" (BC serviceable); no report next sortie.

5th Action: No problem next sortie.

Activity Sequence

8 Checked NDEP--read INS output

Good

9 Checked TFR, both channels

No fail lite but display poor

10 Sought to improve video; retuned both antenna/receiver channels

11 Repeated video checks of TFR displays

Better video but still unsatisfactory

12 Requested Tech. Rep. assistance

13 Hooked up breakout box to allow test access to LRU circuitry

14 Checked pulses with oscilloscope using breakout box

Poor scope presentation

FIELD OBSERVATION SUMMARY

Rand ID 105 **Work Center** 24360 **System** 73H,K,S+C

Activity Sequence

15 Tech Rep suggested receiver antenna replacement--this was done

Better but not completely satisfactory

16 Wrote up for in-flight checkout

17 Checked INS drift via NDEP readouts

Within tolerance

18 End of Job

FIELD OBSERVATION SUMMARY

Rand ID 106 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	098B192				
TM	B				
WUC	14 HAB				
AT	Q				
WD	F				
HM	799				
Start:	08:1730				
Stop:	08:1910				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Job consisted of installing a damper servo.

The installation was made based on memory of procedures which had been learned in OJT.

AIRCRAFT FOLLOWUP:

This JCN does not appear in discrepancy listings. No 14H problems next sortie.

Activity Sequence

1 Install damper servo

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 107 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0980620				
TM	B				
WUC	52 A00				
AT	X				
WD	F				
HM	799				
Start:	08:2145				
Stop:	08:2300				
Skill	7,5,3				

NARRATIVE OF MAINTENANCE ACTION:

A trim problem was reported. (It had been CNDed previously.) This MM could still find no problem. He suggested an in-flight ops check.

The tasks were done from memory, but were learned from OJT and by reading the Tech. Order.

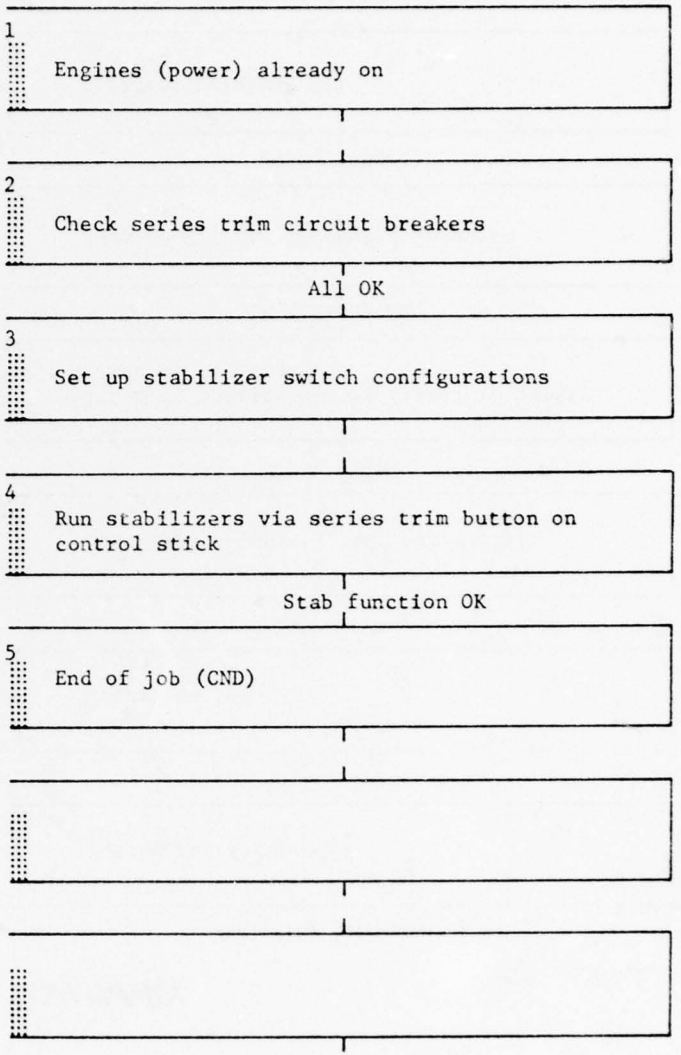
EXPERT COMMENT:

Both evaluators agreed that before the job was CND, the pitch and roll computers should have been checked.

AIRCRAFT FOLLOWUP:

No record this JCN in a/c history. No 52A write-up next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 108 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0930664				
TM	B				
WUC	73 HPO				
AT	Q				
WD	F				
HM	799				
Start:	01				
Stop:	080300				
Skill	080430				

NARRATIVE OF MAINTENANCE ACTION:

Fault was claimed to be that the WDC would not come up. It was not considered part of the problem when task 3 indicated it was good. Yet when other solutions failed a WDC swap was tried (task 8). The problem was finally solved by replacing the GNC. (AT should have been R.)

Except for specific computer addresses, where the T.O. was examined, all else was done from memory

The use of the T.O., which had been taught in Tech. School, was of particular use in steps 2, 3, 5 and 10. All other tasks were learned in OJT.

EXPERT COMMENT:

Further work with computer readouts would have narrowed indication to WDC & GNC. Converter set (C/S) not likely--should not have been swapped. Second comment was JSA.

AIRCRAFT FOLLOWUP:

The AT code or narrative appears in error. A pull of the unit was made on the swing shift prior to this action. The TS

Activity Sequence

1. Set up AGE (-60, -10)
2. Turned on DCC
3. Addressed computer; read error trap

WDC down

4. Tried to operate WDC by itself to verify its failed status.

It came up OK

5. Swapped C/S and Addressed Computer

No improvement

6. Replaced original C/S
7. Swapped WDC

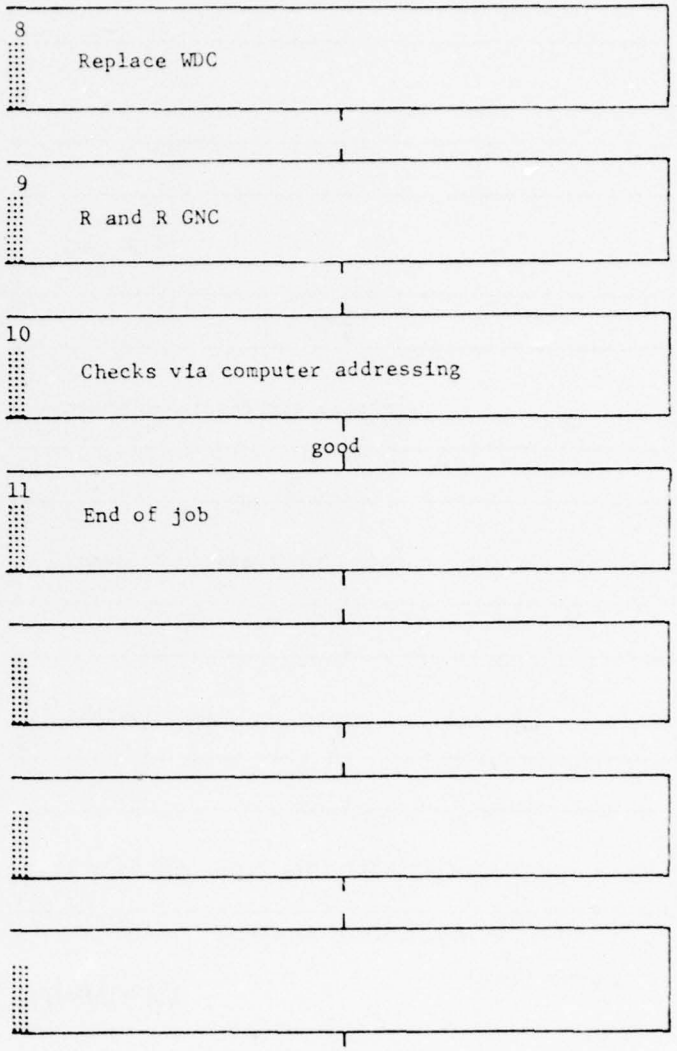
Still did not come up

FIELD OBSERVATION SUMMARY

Rand ID 108 **Work Center** A Shop **System** 73H

started work on this LRU at the same time another LRU was being installed. T.S. actions were all A, 290. No 73H 349s resulted from the next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 109 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0940079				
TM	B				
WUC	73SCO				
AT	Q				
WD	F				
HM	799				
Start:	08:0200				
Stop:	08:0300				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The installation of an NDDP was required. It was done and it operated satisfactorily.

All tasks of this job were performed according to memory.

OJT was credited with almost all of the necessary know-how, except that FTD had provided some of the knowledge required to put all the systems into operation (step 2).

EXPERT COMMENT:

Both JSA.

AIRCRAFT FOLLOWUP:

Data missing regarding this JCN. Sortie at 19:20 on the 8th again listed problems in the 73S system.

Activity Sequence

1 Set up AGE (-60, -10, lightall)

2 Install NDDP

3 Power up systems; DCC, etc.

4 Check NDDP displays (visual)

Good

5 End of job

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ANALYSIS OF THE CONTENT OF ADVANCED AVIONICS MAINTENANCE JOBS.(U)
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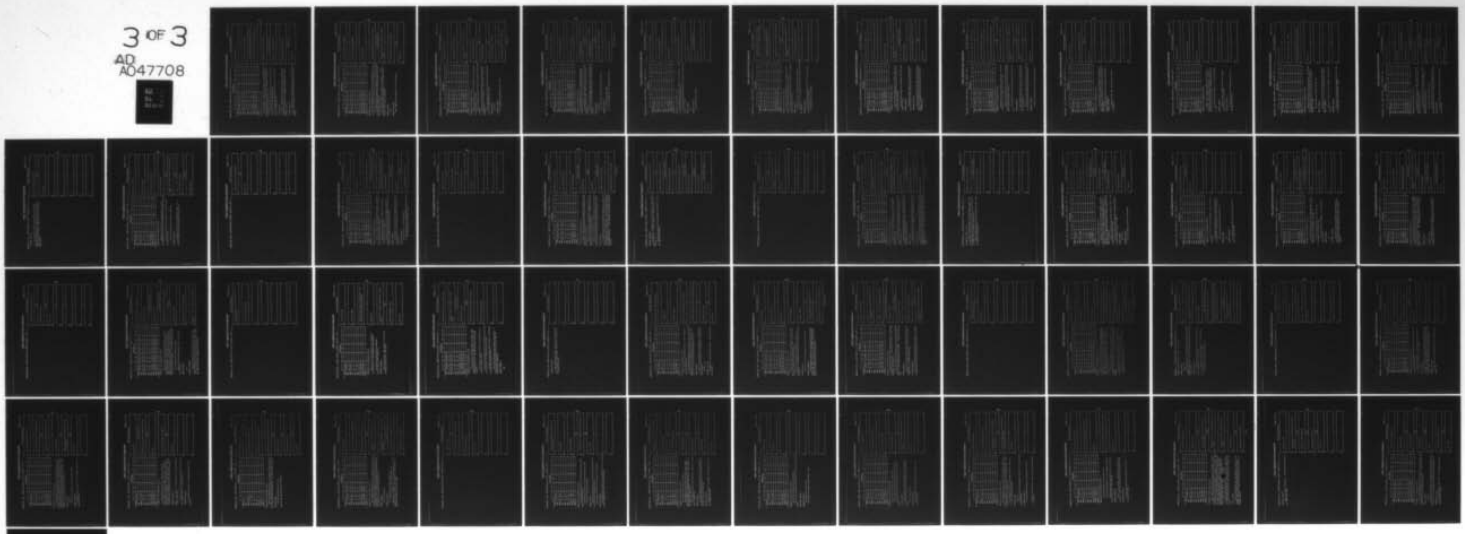


END
DATE FILMED
1 -78
DDC

FIELD OBSERVATION SUMMARY

Rand ID 110 Work Center A Shop System 73S & 73K

349 Data

	1	2	3	4	5
JCN	0940680	0940681			
TM	B	B			
WUC	73 SBO	73 K00			
AT	P	X			
WD	F	F			
HM	242	799			
Start:	080300	080500			
Stop:	080500	080600			
Skill					

NARRATIVE OF MAINTENANCE ACTION:

Report was of a constant CHALL lite. It was deduced, partly from the history of previous maintenance on this aircraft, that the fault was in the DCU. Its replacement resulted in a successful ops check of the TFR.

This MM performed his tasks based on his memory of procedures, which were learned through OJT.

Tech school had acquainted him with the T.O.s; FTD had been of no practical use.

EXPERT COMMENT:

FIRST: Changing the DCU was a good guess. Often just-replaced components fail. Normally would R&R the EPU, then the DCU. An example of very good trouble-shooting. Second comment was JSA.

AIRCRAFT FOLLOWUP:

Not listed in A/C history--apparent error in data collection system. No discrepancy reports next flight (4/8) on either system.

Activity Sequence

1 Power already on

2 Turned on systems; IDS, TFR, ARS

ARS did not come up (caused CHALL lite)

3 Checked a/c forms - DCU changed previously

4 Disconnected right DCU; test ARS

ARS OK (indicated DCU)

5 Removed and replaced right DCU

6 Check TFR operation (visual)

video good

7 End of job

FIELD OBSERVATION SUMMARY

Rand ID 111 Work Center C Shop System 76L & 76K

349 Data

	1	2	3	4	5
JCN	0970471	0970470			
TM	B	B			
WUC	76 L00	76 KP0			
AT	X	P			
WD	F	F			
HM	799	290			
Start:	08 0200	08 0300			
Stop:	08 0300	08 0330			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The first discrepancy was that the IR unit failed test 3; the 2nd was a failure on the part of the ALQ-94 high band antenna.

No corrective action was done regarding the first discrepancy, as it ops checked good (CND). For the other problem, the high band receiver was removed.

The Technical Order was followed very closely. Procedures had been learned at FTD and through OJT. (FTD seemed to be a repeat of Tech. School at Keesler).

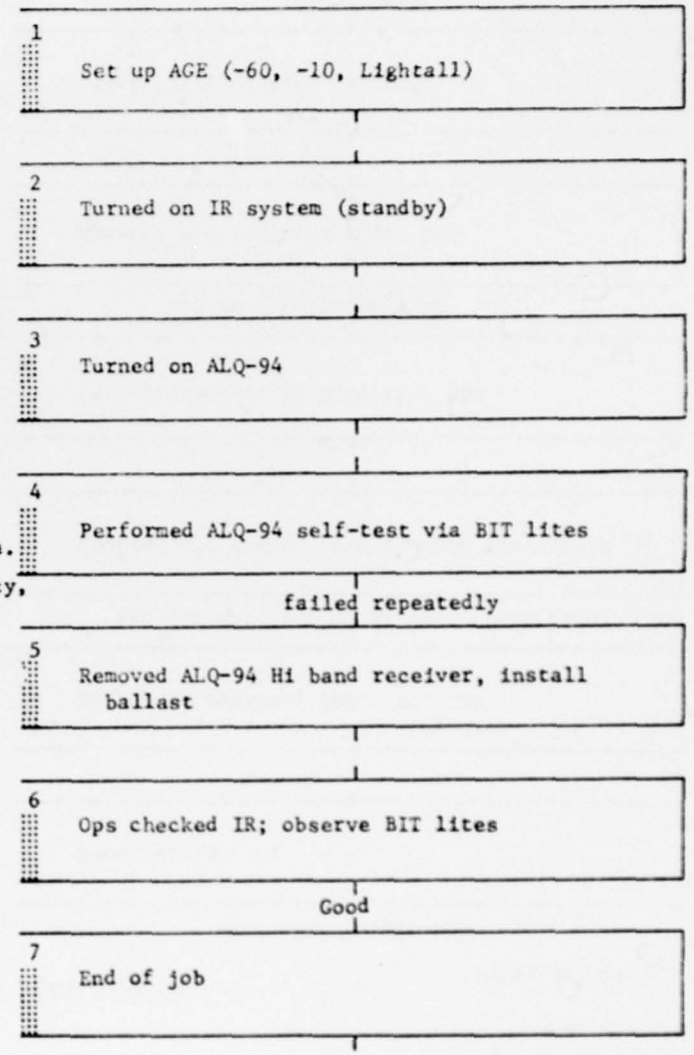
EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

Next flight on 4/9 reported no 76L or K problems.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 112 Work Center C Shop System 71C&65A

349 Data

	1	2	3	4	5
JCN	0970767	0970765			
TM	B	B			
WUC	71 C00	65 ACD			
AT	H	L			
WD	D	D			
HM	799	246			
Start:	080130	080305			
Stop:	080300	080450			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

Reports were of an: 1) ILS off Flag and 2) the IFF panel had been installed backwards.

The ILS checked out good; the IFF was removed and reinstalled correctly.

The first four tasks after setting up AGE were done while following closely T.O. procedures. Tasks 6 and 7 required no directives!

OJT was important to all tasks but the FTD also provided info of use regarding tasks 2 and 3.

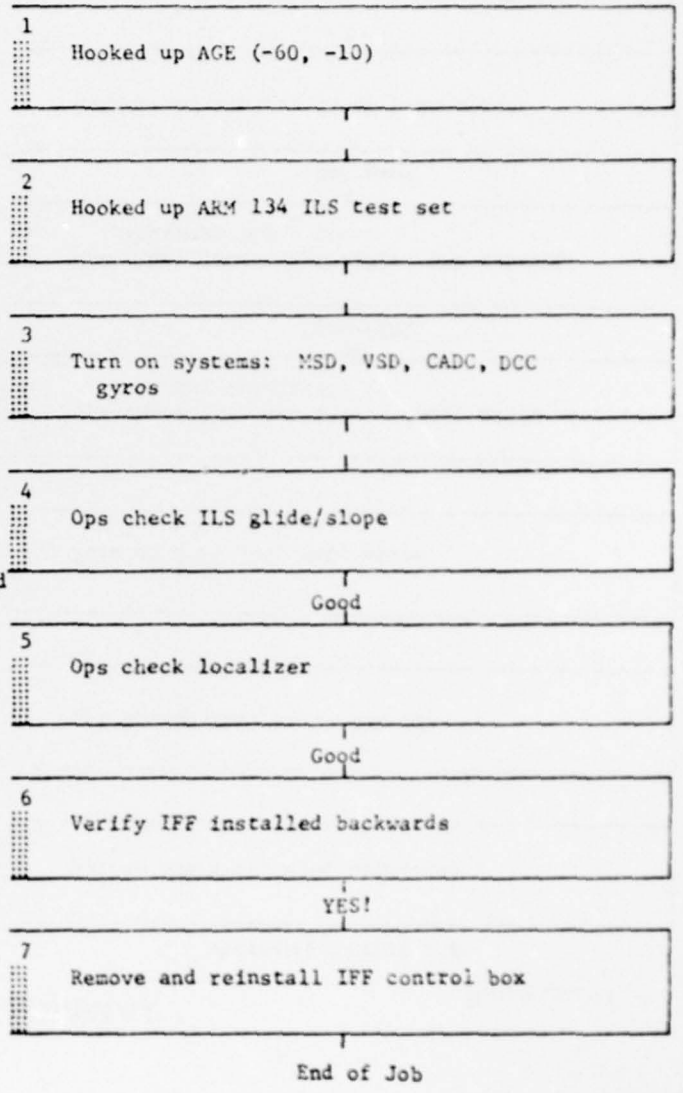
EXPERT COMMENT:

Both--JSA.

AIRCRAFT FOLLOWUP:

No problems these systems on next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Ra[illegible] ID 113 Work Center C Shop System 71B&C

349 Data

	1	2	3	4	5
JCN	0970703	0970716	0970716		
TM	B	B	B		
WUC	71 C00	71 B00	71 BA0		
AT	H	Y	R		
WD	D	D	D		
HM	799	657	657		
Start:	080600	080630	080700		
Stop:	080630	080700	080730		
Skill	5,5	5,5	5,5		

NARRATIVE OF MAINTENANCE ACTION;

The discrepancies were: 1) a glide-slope symbol which flashed on and off (the ILS) and 2) the TACAN DME was weak.

All tasks except 6 were performed with very careful attention to the technical order. Task 6 was done from memory of procedures.

The FTD had provided some useful instruction regarding Tech. order use; most of the knowledge required for this job resulted from OJT.

EXPERT COMMENT:

1st--JSA.

2nd--Should have used ARM 113 Test Set at step 4.

AIRCRAFT FOLLOWUP:

1) No 71C trouble next flight

2) & 3) TS repaired unit. No problems next sortie.

Activity Sequence

1 Set up AGE (-60, -10, Lightall)

2 Set up ILS Test Unit--ARM 134

3 Turn on DCC, IDS, MSC, gyros

4 Ops check ILS (ARM 134): Check glide slope, including localizer

Good--CND

5 Ops check TACAN (HLI-119): DME setting Azimuth setting, etc.

Not good

6 Remove and replace TACAN transmitter

7 Ops check (as in task 3)

Good; End of job

FIELD OBSERVATION SUMMARY

Rand ID 115 Work Center C Shop System 76L

349 Data

	1	2	3	4	5
JCN	0940716				
TM	B				
WUC	76 L00				
AT	L				
WD	D				
HM	127				
Start:	090005				
Stop:	090130				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This resulted from a report of an IR system cryogenic failure. It recycled OK and was considered a CND.

The job was performed from memory of procedures learned previously on the job.

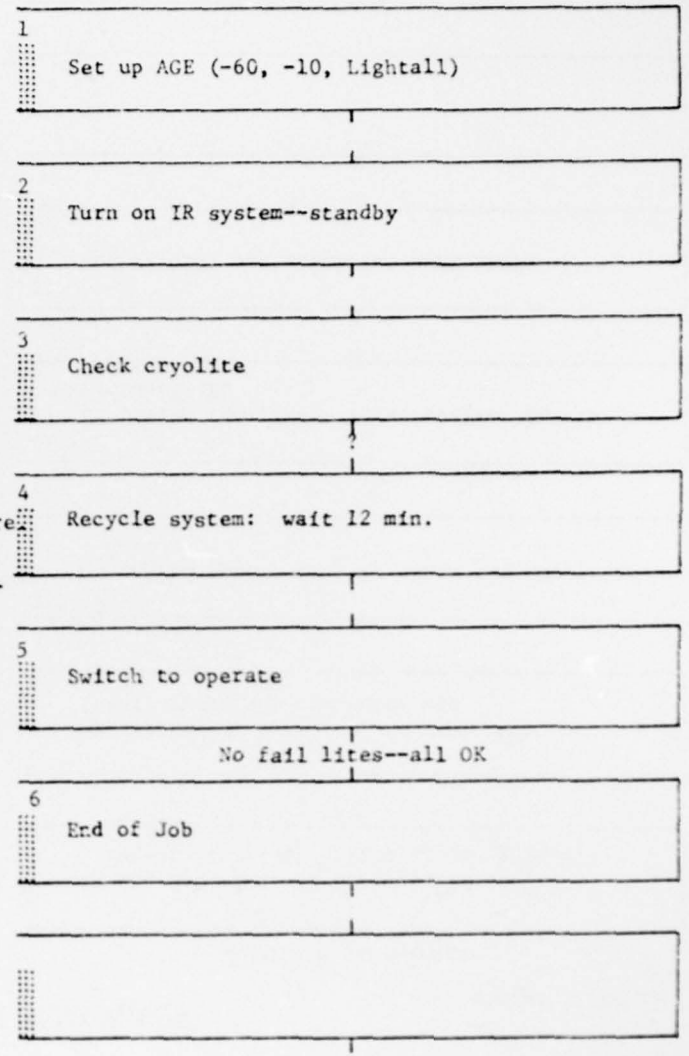
EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No 76L write-up next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 116 Work Center C Shop System 71C

349 Data

	1	2	3	4	5
JCN	0940720	0940720			
TM	B	B			
WUC	71 C00	71 CB0			
AT	Y	R			
WD	D	D			
HM	242	242			
Start:	08 0200	08 0410			
Stop:	08 0400	08 0730			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The ILS had no glide/slope symbol. The receiver was replaced. (The next shift performed the ops check.)

The tasks were performed according to memory of procedures learned previously in OJT.

EXPERT COMMENT:

1st--JSA except for criticism "didn't use AILA code."

2nd--MM should have used ARM 134 test set to check G/S Receiver MSD, and VSD.

AIRCRAFT FOLLOWUP:

71CBO later failed diagnostic test in TS and was found to have broken indicator assembly.

No problems in 71C next flight.

Activity Sequence

1. MM checked aircraft history; it showed a recent R&R of the glide slope receiver
2. MM suspected, based on his experience, a failure in the converter set
3. MM called upon A Shop to check the converter set.

C/S OK

4. MM pulled the glide/slope receiver and replaced it.
5. End of job; ops check due next shift

FIELD OBSERVATION SUMMARY

Rand ID 117 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0970719	0970719			
TM	B	B			
WUC	52 ABO	52 ABA			
AT	Y	R			
WD	D	D			
HM	374	374			
Start:	08:0300	08:0600			
Stop:	08:0600	08:0700			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The pitch gain changer lite and channel lite came on in flight. After troubleshooting the pitch computer, it was removed and replaced.

The MM relied on memory of procedures which had been learned via OJT.

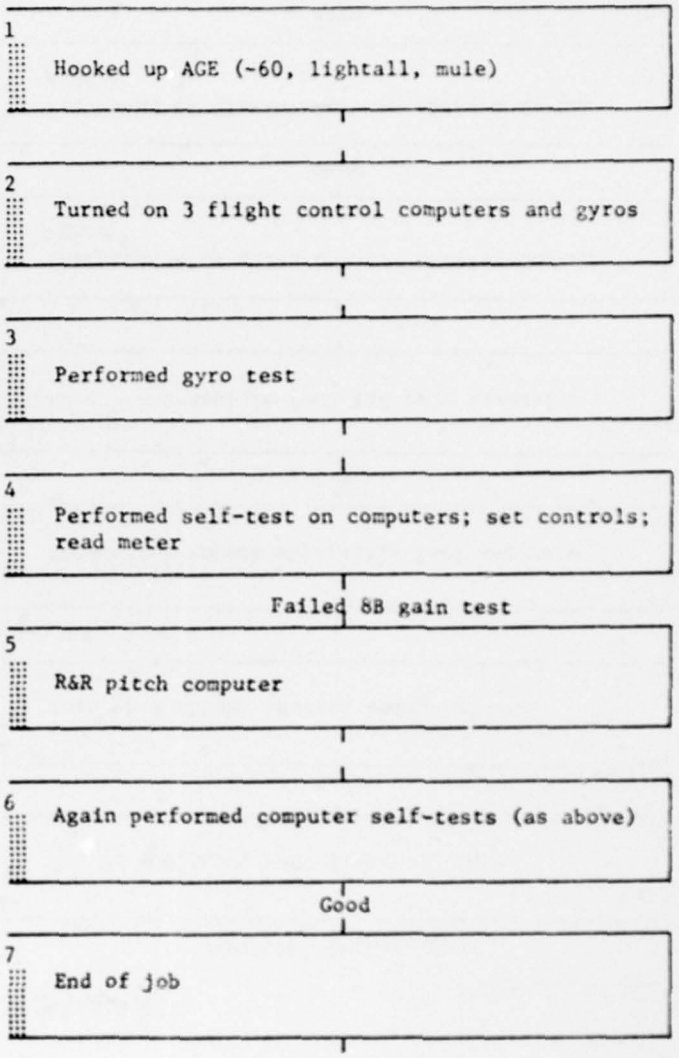
EXPERT COMMENT:

The TFR auto flight control tie in test should have been performed after the computer self test in step 6.

AIRCRAFT FOLLOWUP:

Six TS actions followed this R&R. All were coded as bench check-serviceable with how malfunctioned being "No defect." No further 52A actions listed next 6 flights (through April).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 118 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0970678	0970678			
TM	B	B			
WUC	52 A00	52 ADA			
AT	Y	R			
WD	F	F			
HM	374	374			
Start:	09:0100	09:0305			
Stop:	09:0300	09:0415			
Skill	5,3,5	5,3,5			

NARRATIVE OF MAINTENANCE ACTION:

Report was of a pitch channel lite problem. MM found a bad feel and trim assembly and replaced same.

Operation of the system was done from memory; however, the ops check after the feel and trim assembly installation was a direct following of the T.O.

The procedures of the tasks were learned while on-the-job.

EXPERT COMMENT:

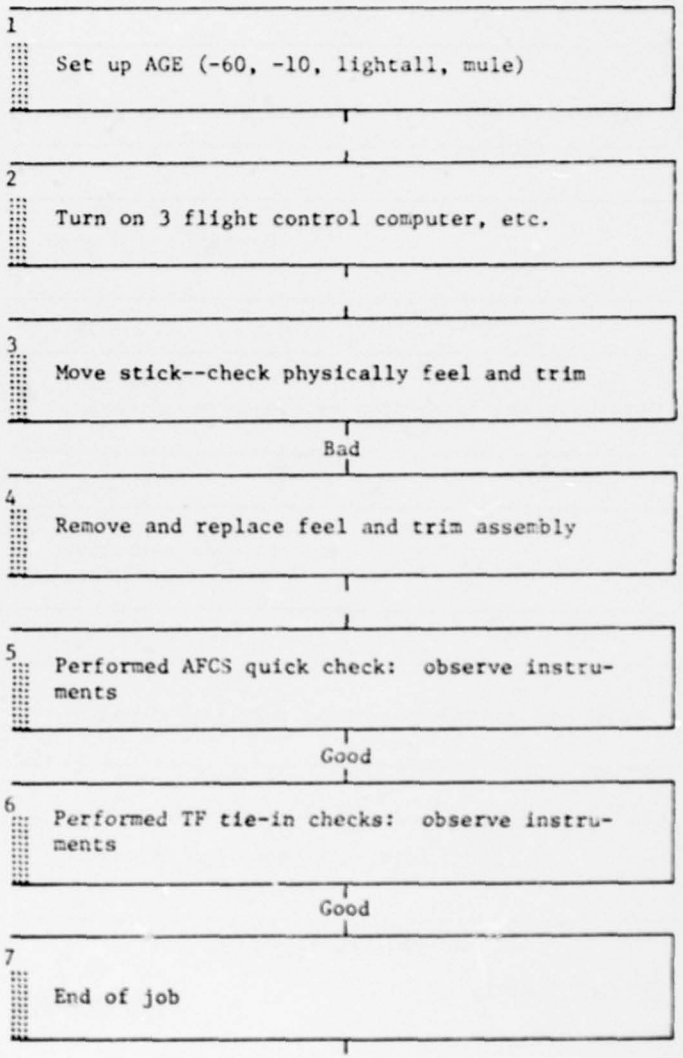
The physical feel of feel and trim is unreliable with mule power--should have done a quick check before R&R feel and trim assembly.

MM should also have done STAB augmentation test instead of a quick check after replacing feel and trim assembly.

AIRCRAFT FOLLOWUP:

No record of aircraft 8135 in discrepancy listings.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 119 Work Center B Shop System 14H

349 Data

	1	2	3	4	5
JCN	0910463				
TM	B				
WUC	14 HAA				
AT	S				
WD	F				
HM	800				
Start:	09:0530				
Stop:	09:0640				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

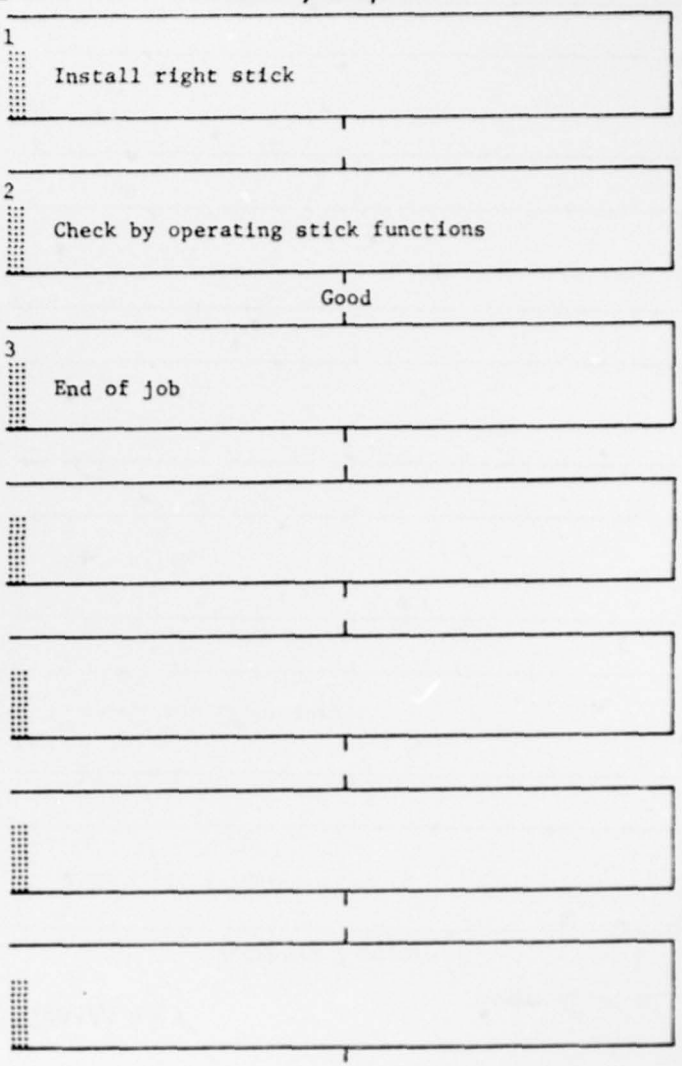
It was necessary to install right stick (which had been removed for other maintenance (FOM)). (AT code indicates remove and reinstall.) It must also have required safety wiring.

The tasks were performed from memory of procedures learned through O.JT.

AIRCRAFT FOLLOWUP:

No listing of this JCN. Next sortie on 4/30; no 14H write-up.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 120 Work Center B Shop System 51F

349 Data

	1	2	3	4	5
JCN	0980451				
TM	B				
WUC	51 FAA				
AT	P				
WD	F				
HM	846				
Start:	09:0655				
Stop:	09:0745				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

A hole, due to physical damage, was noted in the pitot tube. It was removed and replaced. Technique required working with potting material and special tools. No indication of an ops check. (Should be AT code R.)

The job was done from memory. It had been learned in OJT.

EXPERT COMMENT:

Should have used a TTU205 C/E tester to perform pressure test in an ops check.

AIRCRAFT FOLLOWUP:

No record of this JCN in discrepancy report. No 51F reports all month.

Activity Sequence

1 Remove pitot tube

2 Install new pitot tube

3 End of job

FIELD OBSERVATION SUMMARY

Rand ID 121 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0940722				
TM	B				
WUC	51 ABE				
AT	X				
WD	D				
HM	799				
Start:	09:0620				
Stop:	09:0700				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

The MM was required to ops check the HSI. He reviewed the applicable T.O. prior to starting the job, then he followed the Technical Orders partially by occasional reference to them.

This procedure was learned through OJT.

EXPERT COMMENT:

MM apparently omitted two operations between items 2 and 3 of step 3, i.e., to slave off heading and to slave back to heading.

There was no need to turn on computers and CADC--only the gyro.

AIRCRAFT FOLLOWUP:

This action followed an R&R of the previous day. Next sortie generated a 51A discrepancy (51ABM)

Activity Sequence

1. Set up AGE (-60)
2. Turned on computer, gyro, and CADC
3. Check HSI operations: 1) slave to heading, 2) turn to DG, 3) turn to compass at auto mode
4. End of job

FIELD OBSERVATION SUMMARY

Rand ID 122 Work Center B Shop System 52A

349 Data

	1	2	3	4	5
JCN	0970726				
TM	B				
WUC	52 ABA				
AT	R				
WD	D				
HM	374				
Start:	07:0400				
Stop:	09:0715				
Skill	5,5,5				

NARRATIVE OF MAINTENANCE ACTION:

Discrepancies involved the pitch channel lite and the gain changer lite (intermittent). Remedy was to remove and replace the pitch computer.

This MM followed the Tech. Order very closely. Task 5 is not called for in the T.O. and for task 6, memory of R&R procedures was sufficient.

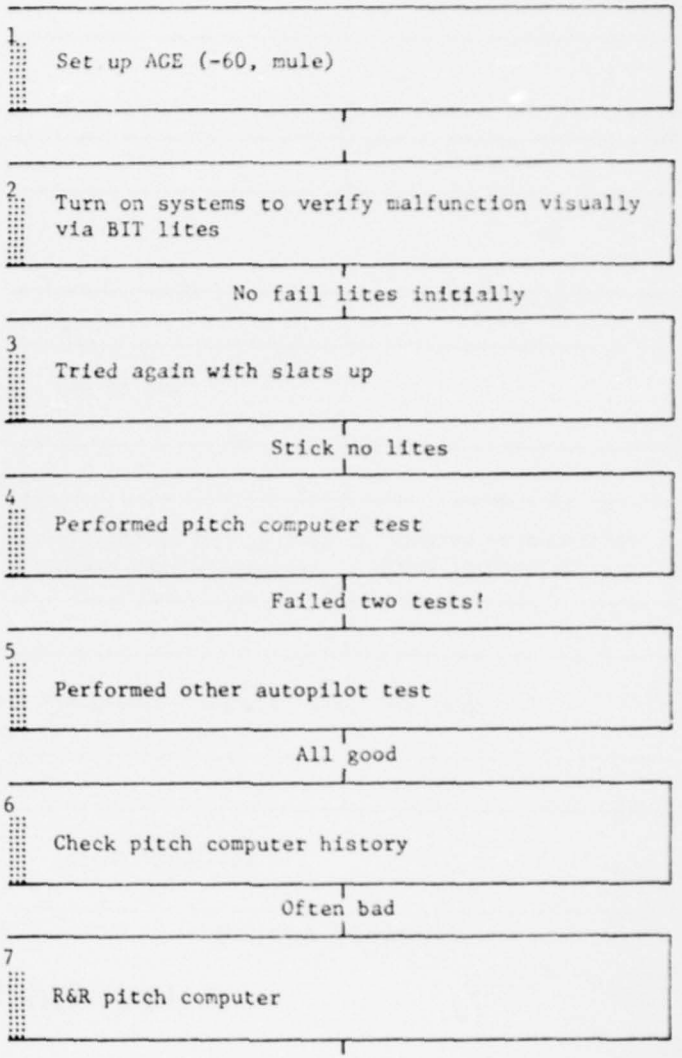
All tasks had been learned via OJT.

MM commented that Tech. School consisted of system familiarization; also that the Tech Orders were well written.

EXPERT COMMENT:

Should have done TFR auto flight control tie-in test at end of job.

Activity Sequence



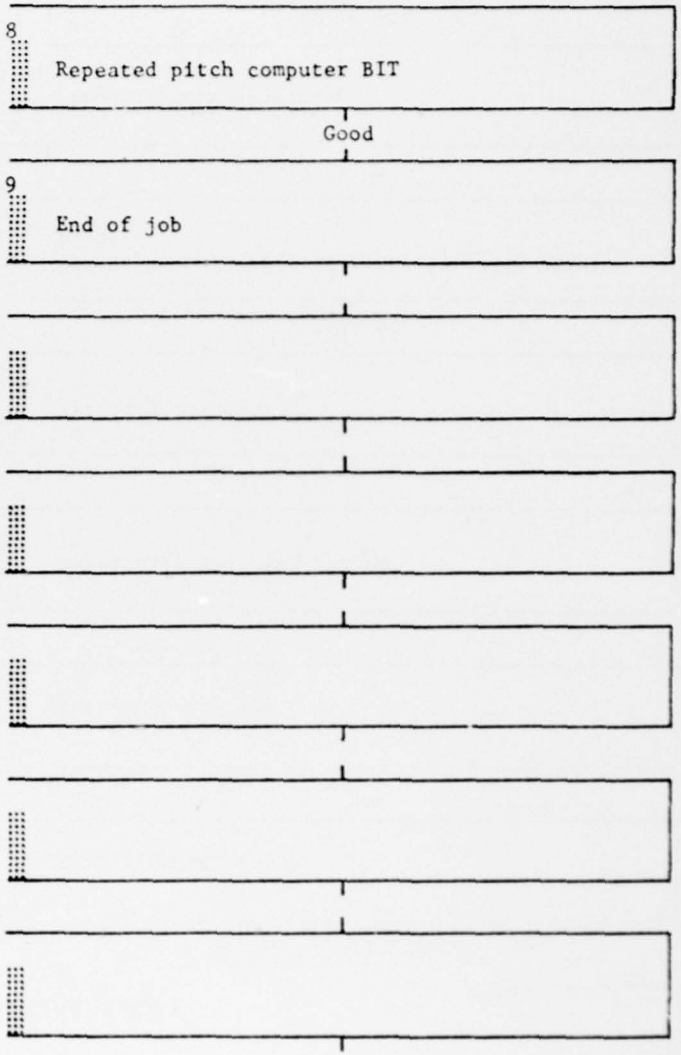
FIELD OBSERVATION SUMMARY

Rand ID 122 Work Center B Shop System 52A

AIRCRAFT FOLLOWUP:

TS repaired the pitch computer which had failed diagnostic/automatic test. Next two sorties had repeat write-ups on this unit. TS repaired unit after first of these, but found no defect after the second. No write-up next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 123 Work Center B Shop System 52B

349 Data

	1	2	3	4	5
JCN	0980456				
TM	B				
WUC	52 BCA				
AT	Y				
WD	F				
HM	374				
Start:	09:0415				
Stop:	09:0700				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Angle-of-attack top lite was reported out. Wiring was determined at fault and the AOA detector assembly replaced.

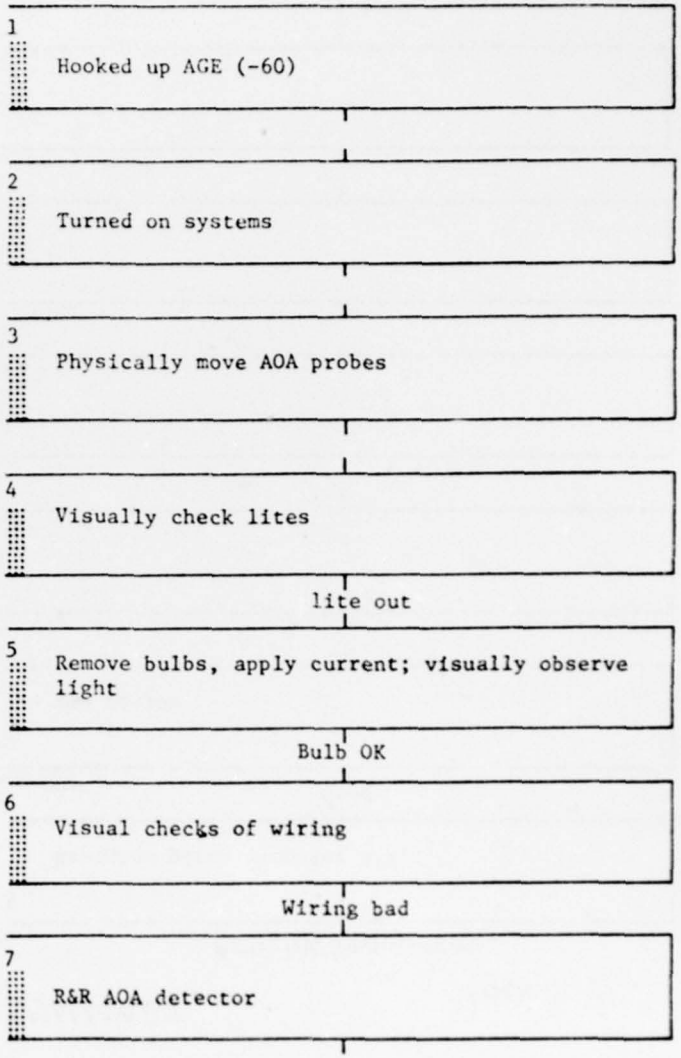
The technical order was referred to at times as this job was being done.

All task actions had been learned through OJT.

AIRCRAFT FOLLOWUP:

No listing of this JCN in discrepancy report. No 52B 349 actions listed for preceding or next sortie.

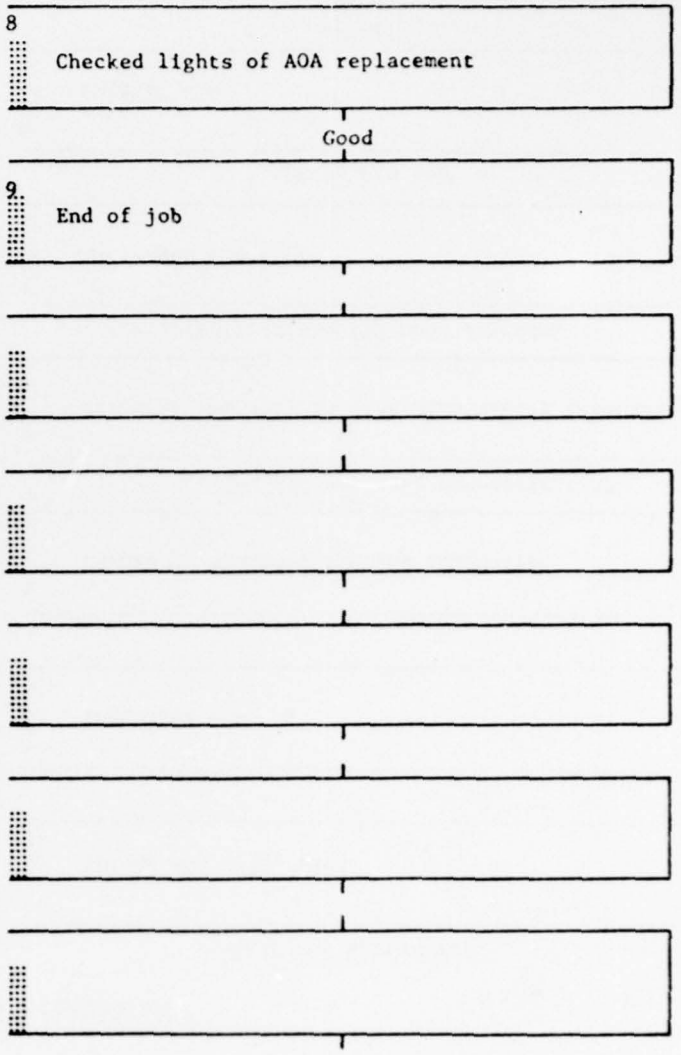
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 123 Work Center B Shop System 52B

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 124 Work Center A Shop System 73 H

349 Data

	1	2	3	4	5
JCN	0930729	0930729			
TM	B	B			
WUC	73 HCO	73 HAO			
AT	Q	R			
WD	D	D			
HM	242	242			
Start:	090005	090335			
Stop:	090335	090345			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

Job was to consist of installation of an NCU. Following this an IND mode degrade was indicated. Further checking led to a bad IRU, which was replaced.

These tasks were performed from memory, the procedures having been learned through OJT.

There were no indications from the testing system to warrant IRU replacement, but the MM thought that the other reasonable alternative had been already tried.

EXPERT COMMENT:

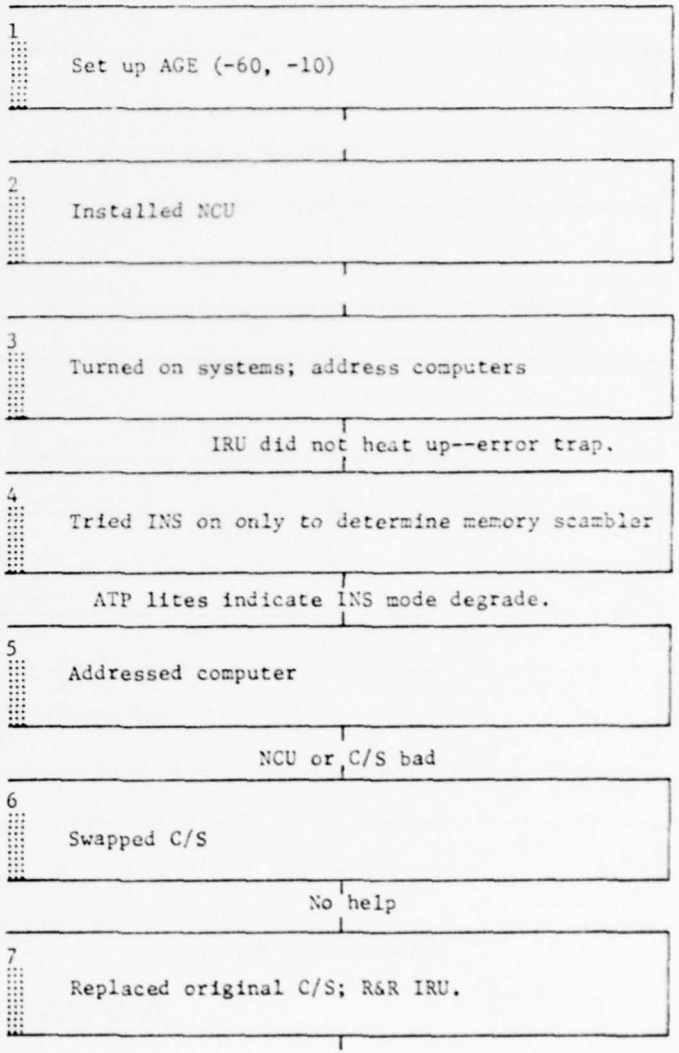
One evaluation was JSA; the other concluded that this was an unusual sequence of operations and that it was hard to see role of IRU.

AIRCRAFT FOLLOWUP:

1) No TS action; no work next flight.

2) System A,290 at TS. (Bench checked, repaired with how mal = Fails diagnostic/automatic test.)

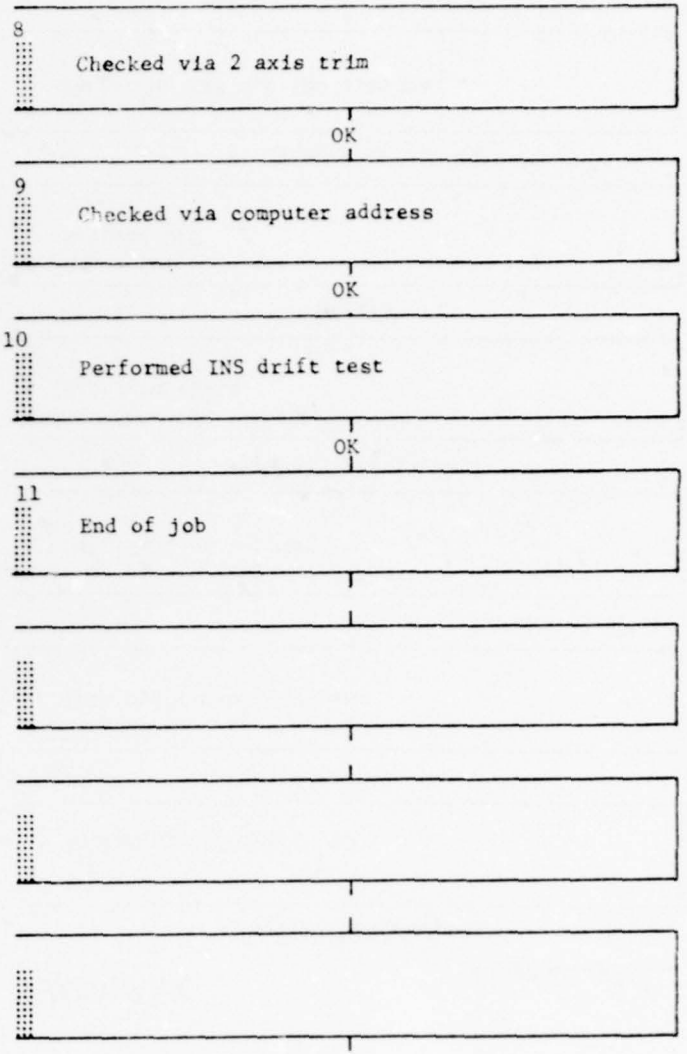
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 124 Work Center A Shop System 73 H

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 125 Work Center 24360 System 73P & Q

349 Data

	1	2	3	4	5
JCN	0910721	0910701			
TM	B	B			
WUC	73 QBO	73 PBO			
AT	P	R			
WD	D	D			
HM	242	242			
Start:	090300	090200			
Stop:	090400	090300			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

Problems existed with doppler ground speed and with the ARS (weak video). The Doppler Electronics Unit was removed and the EPU removed and replaced.

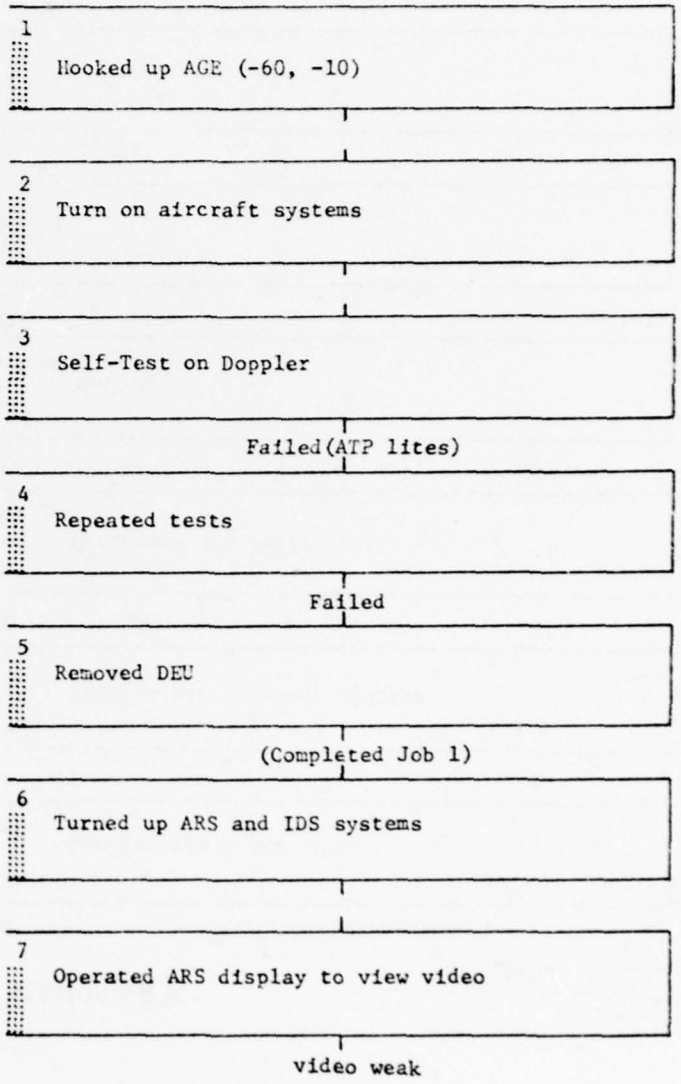
All tasks, except when addressing the computer, were done from memory. The exceptions (tasks 8 & 14) required use of technical orders to insure against errors.

While the contribution of technical school and FTD were considered minimal, they did touch on the procedures used in tasks 3, 9, and 15. All other task procedures were learned in OJT.

EXPERT COMMENT:

Two experts questioned the need for steps 10, 11, and 12 relating to low voltage possibility. The first stated that this "has nothing to do with weak video." The second expert advocated some consideration of MCU tape info and also computer addressing for doppler checking. A third declared the procedure reasonably correct.

Activity Sequence



FIELD OBSERVATION SUMMARY

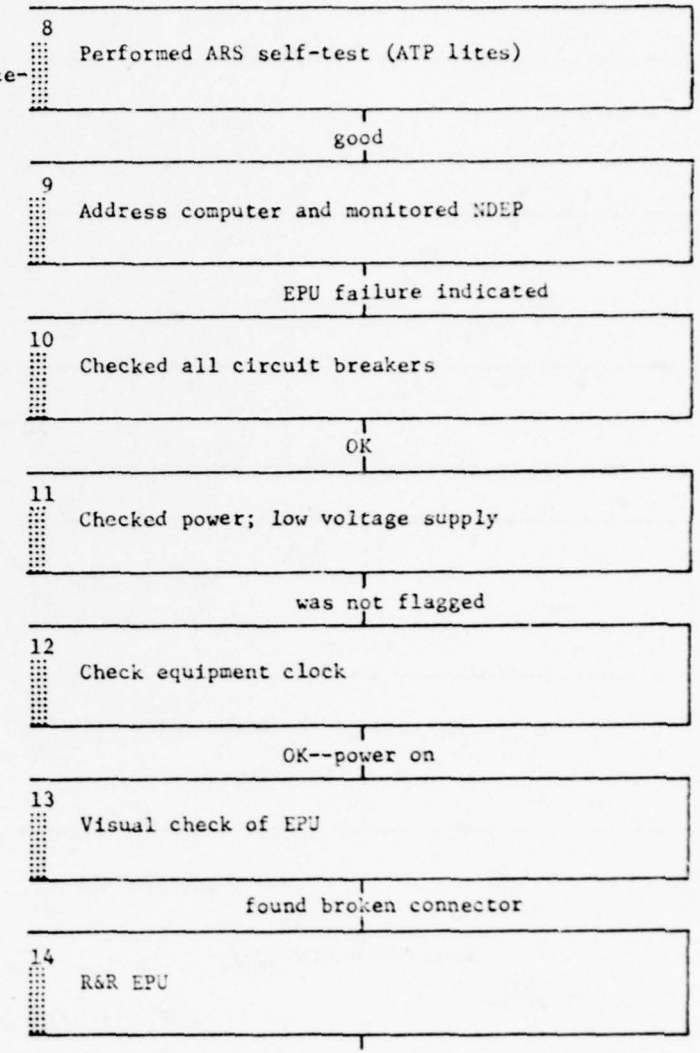
Rand ID 125 Work Center 24360 System 73P & Q

AIRCRAFT FOLLOWUP:

In each of 5 TS actions the 73P system bench checked serviceable (no defect). It did not appear as a write-up on the next sortie.

The 73Q system was also BC-serviceable (no defect) and was not reported next flight.

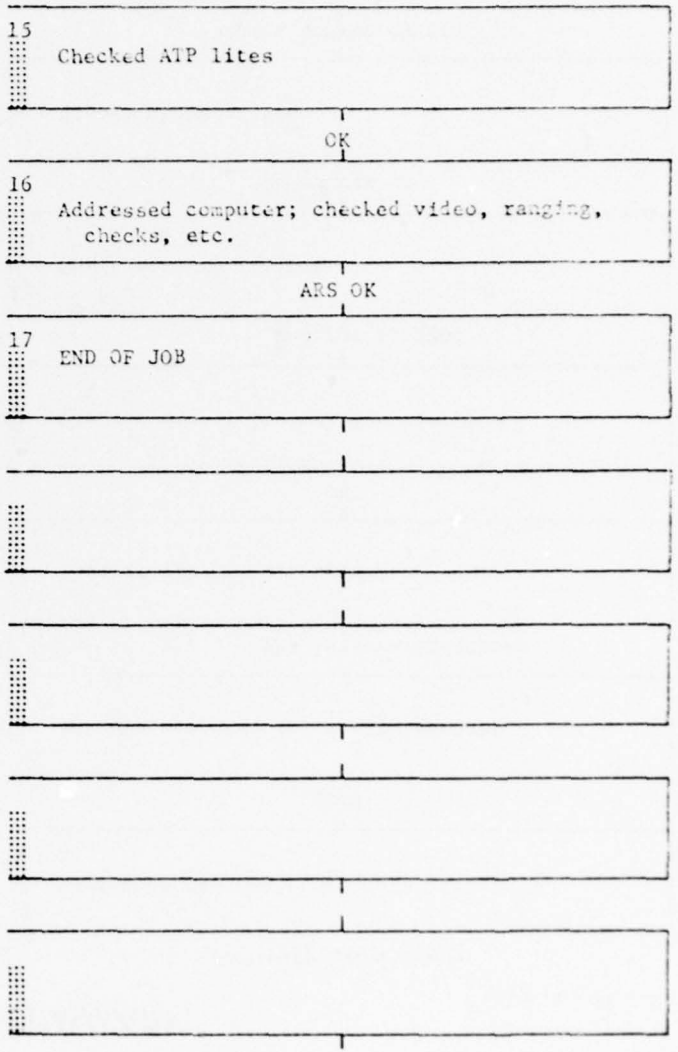
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 125 Work Center 24360 System 73P & Q

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 126 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0970763				
TM	B				
WUC	73 PDO				
AT	R				
WD	D				
HM	242				
Start:	090100				
Stop:	090200				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Three discrepancies were listed: (1) The ARS produced double pulses, (2) there was no ARS video, and (3) the WDC would not come up.

All tasks except for #7 were performed from memory. It required a T.O. to insure correct addresses and interpretation of NDE readouts.

Some tech school training had been received regarding how to address the computer; however, this and all other tasks were learning primarily through OJT.

EXPERT COMMENT:

Two experts felt that computer addressing should have been done in steps 5 or 6. One suggested ATP monitoring in step 3.

AIRCRAFT FOLLOWUP:

Forty-one 349 entries were produced under this job control number of which 19 concerned the 73P system. Eleven more entries regarding 73P resulted from another JCN resulting from an "ARS failed" discrepancy. The first JCN resulted from "INS dump in flight."

Activity Sequence

1. Hooked up AGE (-60, -10, Lightall)
2. Completed R&R of ARS transmitter started by previous shift
3. Operated ARS; visual check of displays

Bad video

4. Removed ARS transmitter (apparent judgment regarding source of bad video)
5. Turn on other systems

WDC and GNC came up

6. Tried WDC and GNC separately

GNC OK, WDC down

7. Swapped WDC units

WDC soon failed

FIELD OBSERVATION SUMMARY

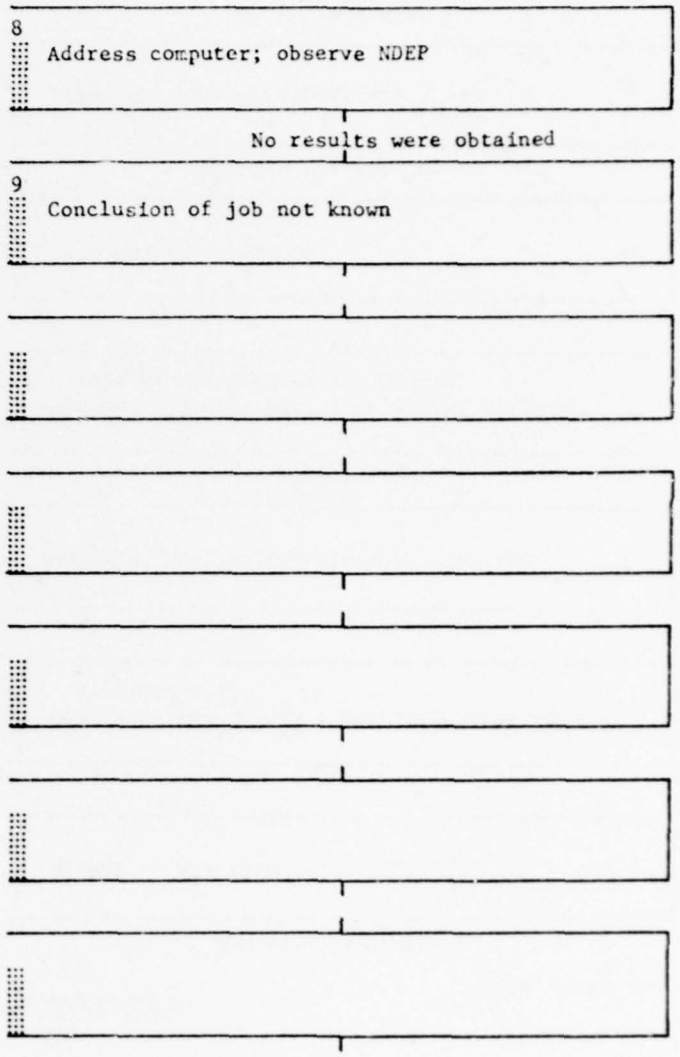
Rand ID 126 Work Center A Shop System 73P

AIRCRAFT FOLLOWUP (cont.):

In both of the responses to the discrepancy reports the aircraft record shows a total of eight TS 73PDO actions. Two of these show BC-serviceable (no defect), the other 6 show BC and repair with how mal=692 (video faulty).

The 73P system was again written up after the next sortie (but not the 73 PDO unit).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 127 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0970717				
TM	B				
WUC	73 KBO				
AT	L				
WD	D				
HM	127				
Start:	090005				
Stop:	090230				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Both TFR channels failed to operate properly. The last task performed by the MM was to tune the antenna frequency, which he said was not suggested specifically in the T.O., for this fault. OJT was the basis for this effort. Actually, the problem was not completely solved--the video presentation, however, was improved.

Except for turning on the systems in task 1, the T.O. procedures were closely followed.

OJT was a factor in all tasks while training obtained at the FTD related to tasks 1, 2, and 5.

EXPERT COMMENT:

Both--JSA.

AIRCRAFT FOLLOWUP:

No T.S. actions; no repeat on this system.

Activity Sequence

1 Hooked up AGE (-60, -10)

2 Turned on avionics systems

3 Ops check TFR - observe displays - OK
- observe fail lites - OK

video weak

4 Checked frequency separation

Set to correct frequency

5 Tuned antenna frequency

6 Checked TFR--visual

Improved video

7 End of job

FIELD OBSERVATION SUMMARY

Rand ID 128 Work Center B Shop System 51F

349 Data

	1	2	3	4	5
JCN	0978501				
TM	C				
WUC	51 FAA				
AT	H				
WD	H				
HM	799				
Start:	08:0200				
Stop:	08:0230				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

A pitot tube was reported plugged. This could not be verified.

The MM knew from memory how to check for this fault. (It was further verified as CND by a 7-level supervisor.)

The task procedure had been learned in OJT.

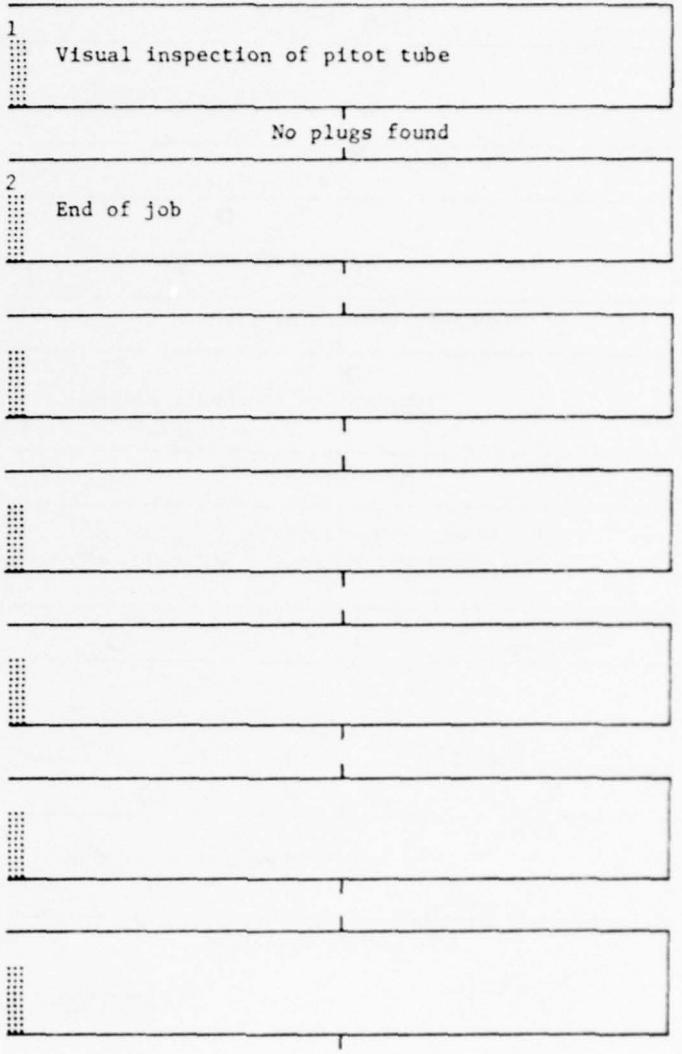
EXPERT COMMENT

JSA

AIRCRAFT FOLLOWUP:

No record of this JCN or of any 51F system work in April on this aircraft.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 129 Work Center B Shop System 14E

349 Data

	1	2	3	4	5
JCN	0970709				
TM	B				
WUC	14 E00				
AT	Y				
WD	D				
HM	812				
Start:	09:0005				
Stop:	09:0230				
Skill	5,5,5				

NARRATIVE OF MAINTENANCE ACTION:

The report was of a delay in slat operation. It was found to be in the indicator. This was one of a very few jobs where a PSM-6 multimeter was used.

The work was turned over to a crew from the Reclamation and Recovery Shop.

The tasks were done from memory. All learning had come from OJT.

EXPERT COMMENT

JSA

AIRCRAFT FOLLOWUP:

JCN listed, but no 349 listed! No 14E write-up on next flight but one did appear (same JCN) 4 sorties later. A slat monitor assembly was R&Red; code was "internal failure."

Activity Sequence

1 Set up AGE (-60, mule)

2 Operate slats

10 second delay in indicator

3 Check slat monitors; locate pins for voltage check (use PSM-6 multimeter)

Out of adjustment; delay in voltage

4 Job was turned over to Reclamation and Recovery Crew

5 End of job (for this Shop)

FIELD OBSERVATION SUMMARY

Rand ID 130 Work Center A Shop System 73R

349 Data

	1	2	3	4	5
JCN	0910701				
TM	B				
WUC	73 RCO				
AT	R				
WD	D				
HM	242				
Start:	080400				
Stop:	080600				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

No scan conversion was reported for ARS-TFR. MM. tracked the problem (see tasks 4 and 5) to the STU, which was replaced. The Tech. order was consulted in tasks 4 and 7. Other tasks were done by memory. The procedures of tasks 4 and 7 were partially learned in FTD; remaining tasks were learned while OJ.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

TS received the LRU and repaired it; "how mal" was "fails diagnostic/automatic test." No 73R write-up on next sortie.

Activity Sequence

1 Hooked up AGE

2 Turned on avionics systems.

3 Checked radar display visually

Scan compressed

4 Checked visually ARS-TFR displays in different modes.

Some problems

5 Addressed computer

Indicated a STU problem.

6 Checked MCU tape

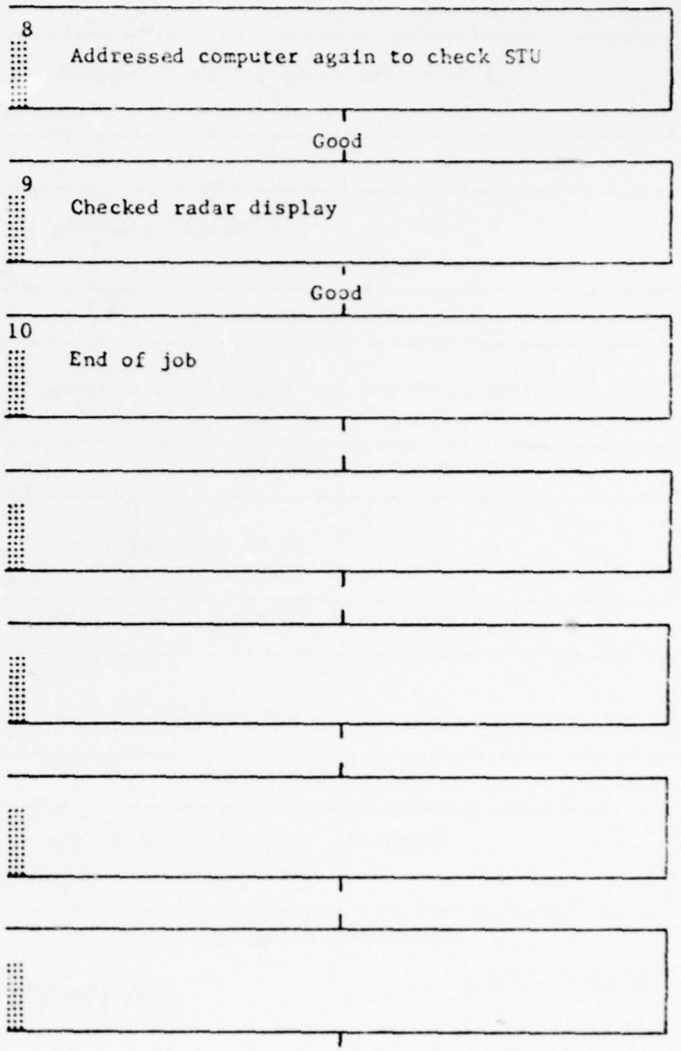
Also indicated STU problem.

7 R&R STU

FIELD OBSERVATION SUMMARY

Rand ID 130 Work Center A Shop System 73R

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 131 Work Center C Shop System 61A

349 Data

	1	2	3	4	5
JCN	0970718	0970718	0970718	0970718	
TM	B	B	B	B	
WUC	61 000	61 AAO	61 ADA	61 ACO	
AT	Y	P	R	P	
WD	D	D	D	D	
HM	242	242	242	242	
Start:	09:0030	09:0150	09:0310	09:0535	
Stop:	09:0145	09:0300	09:0530	09:0700	
Skill	5,5	5,5	5,5	5,5	

NARRATIVE OF MAINTENANCE ACTIONS:

MM was to perform an ops check following a previous tuner installation. He troubleshot the HF system and removed the HF mount. Tasks 5 and 6 were necessary to allow this removal. The decision to remove the mount was based on the conclusion that this was the only fault cause left (after earlier testing). "P" AT codes seem incorrect.

Task procedures were drawn from memory.

Steps 1 and 2 had been learned in FTD. The others were from OJT.

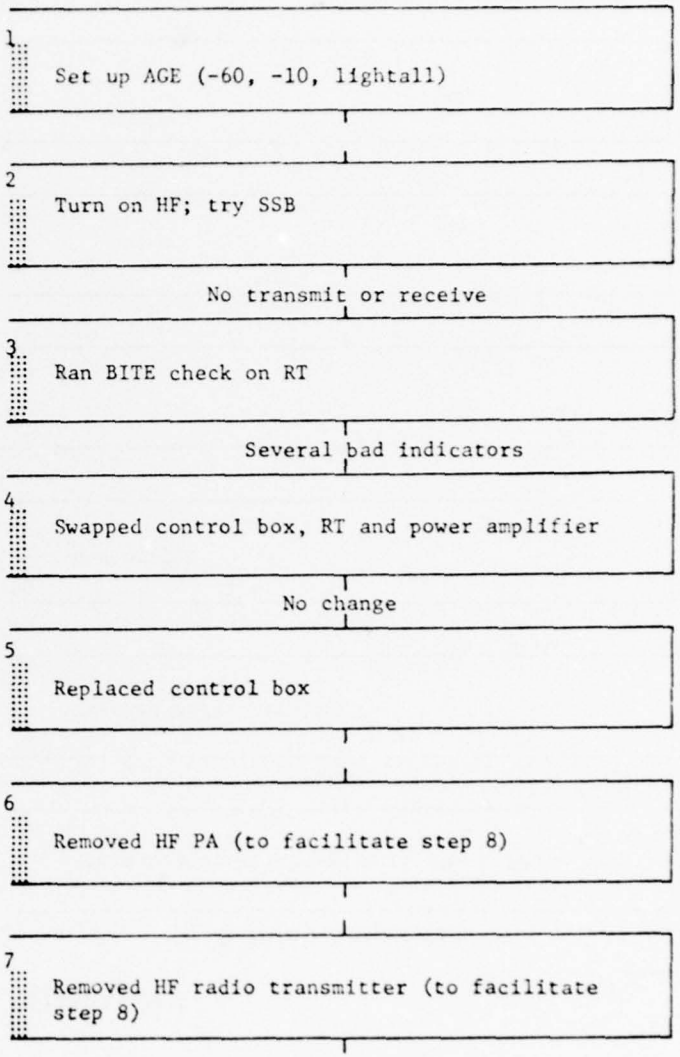
EXPERT COMMENT:

JSA

AIRCRAFT FOLLOWUP:

61 ACO bench checked serviceable by TS, 61 ADA had repair deferred, and 61 AAO is not mentioned again. None of these sytems were in discrepancy listing of next flight. Next sortie after that reported HF inoperative.

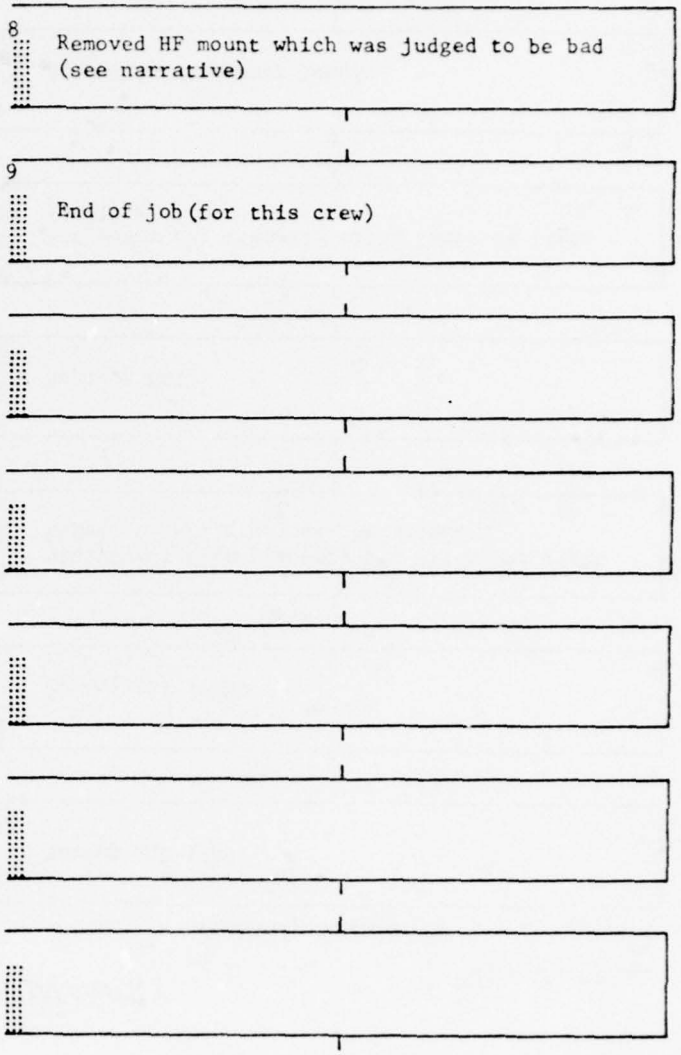
Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 131 Work Center C Shop System 61A

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 132 Work Center B Shop System 51A

349 Data

	1	2	3	4	5
JCN	0970665				
TM	B				
WUC	51 ABE				
AT	G				
WD	F				
HM	070				
Start:	09:0730				
Stop:	09:1040				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Report was of a wire broken on the inclinometer. The light panel on the inclinometer was replaced.

Procedures were performed as remembered. They had been learned through OJT.

AIRCRAFT FOLLOWUP:

This JCN not listed. Next sortie on 4/11 had 510 discrepancy writeup, but no 349 action.

Activity Sequence

1. Set up AGE (-60)
2. Remove HSI (FOM)
3. Disconnect wires; insert new wires and light panel; visually adjust inclinometer
4. Replace HSI
5. Put power on; visually check lites on light panel

Good

6. Adjust inclinometer level
7. End of job

FIELD OBSERVATION SUMMARY

Rand ID 133 Work Center B Shop System 46A

349 Data

	1	2	3	4	5
JCN	0930724	0930724			
TM	B	B			
WUC	46 AAA	46 AAA			
AT	Y	R			
WD	D	D			
HM	935	935			
Start:	06:0900	06:1310			
Stop:	06:1105	06:1520			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The fuel quantity indicator failed in flight. When "press to test" it went to 2000 (OK) but when released, it dropped back to 0. Same thing occurs in hard climb or dive.

This complaint had been acted on by maintenance four times in the last 6 weeks.

This time the MM found the A-1 fuel probe scratched and not in its boot. He replaced this fuel probe.

The tasks were performed based on memory of procedures which had been learned in OJT.

This same problem was reported again next flight. B Shop personnel were climbing into the fuel tanks and making visual inspection.

EXERPT COMMENT:

JSA

Activity Sequence

1 Checked a/c history; set up AGE (-60)

2 Visually checks A-9 through A-12 fuel probes

A-11 not in boot

3 Inspected A-11 probe

Damaged

4 Replaced A-11 probe; safety wire probe

5 End of job (ops check due)

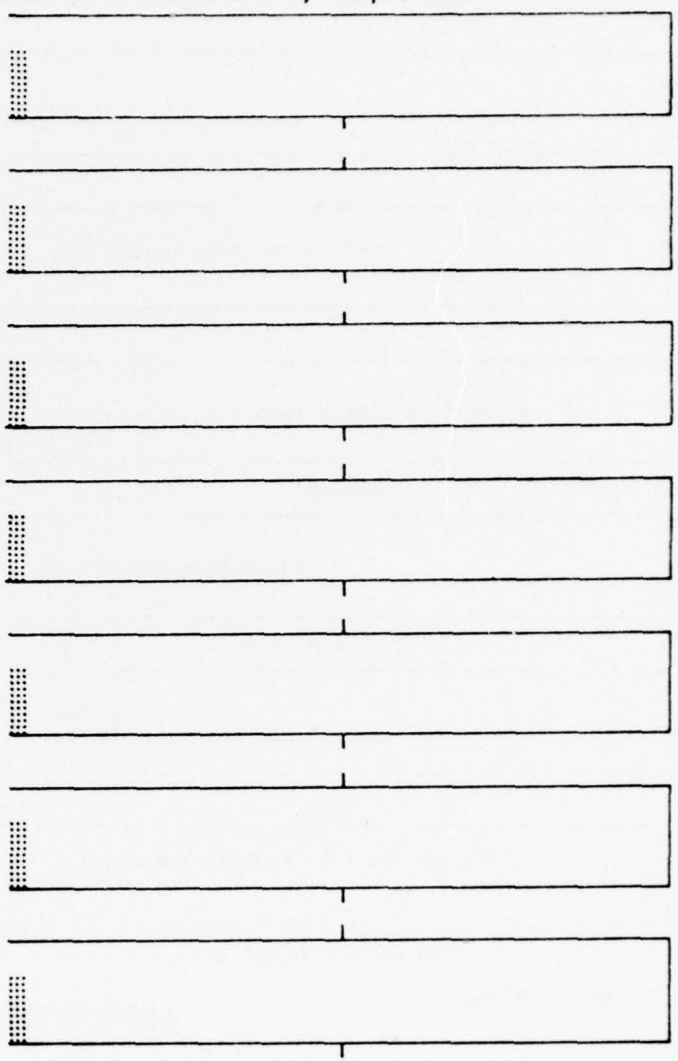
FIELD OBSERVATION SUMMARY

Rand ID 133 Work Center B Shop System 46A

AIRCRAFT FOLLOWUP:

Same problem next flight. Another indicator replacement was made; no discrepancy reports next 2 flights (end of record for April).

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 135 Work Center 24360 System 73H

349 Data

	1	2	3	4	5
JCN	0970744				
TM	B				
WUC	73 HCO				
AT	Q				
WD	D				
HM	799				
Start:	090005				
Stop:	090200				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

Job consisted of the installation of an NCU followed by a check of its operation.

The tasks were performed from memory. The T.O. would have been referred to if tolerances had come into question. All tasks drew on OJT for the know-how to do the job. Some elements of the ops checks had been acquired at the FTD.

EXPERT COMMENT:

FIRST: This ops check was too limited. The MM should have also addressed computers to determine if there were any INS failures.

SECOND: JSA.

AIRCRAFT FOLLOWUP:

No 73HCO T.S. work (Much 73HAO work). Some 73HGO work on next flight.

Activity Sequence

1 Set up AGE (-10, -60, and LIGHTALL)

2 Installed NCU

3 Turned on system

4 Set to NAV align mode for ops check

5 Observe align, aux heading, and altitude lights.

OK

6 Perform drift check

OCG

7 End of job

FIELD OBSERVATION SUMMARY

Rand ID 136 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0970777	0970778			
TM	B	B			
WUC	73SBO	73SGO			
AT	Q	Q			
WD	D	D			
HM	799	799			
Start:	08:1740	08:2030			
Stop:	08:1910	08:2355			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

Discrepancy write-up was of the right DCU--cursors did not move. Also the MCU had produced fail lites on the ATP (and apparently had been removed previously).

All tasks were performed from memory of procedures. Learning was overwhelmingly from OJT with a slight contribution from FTD.

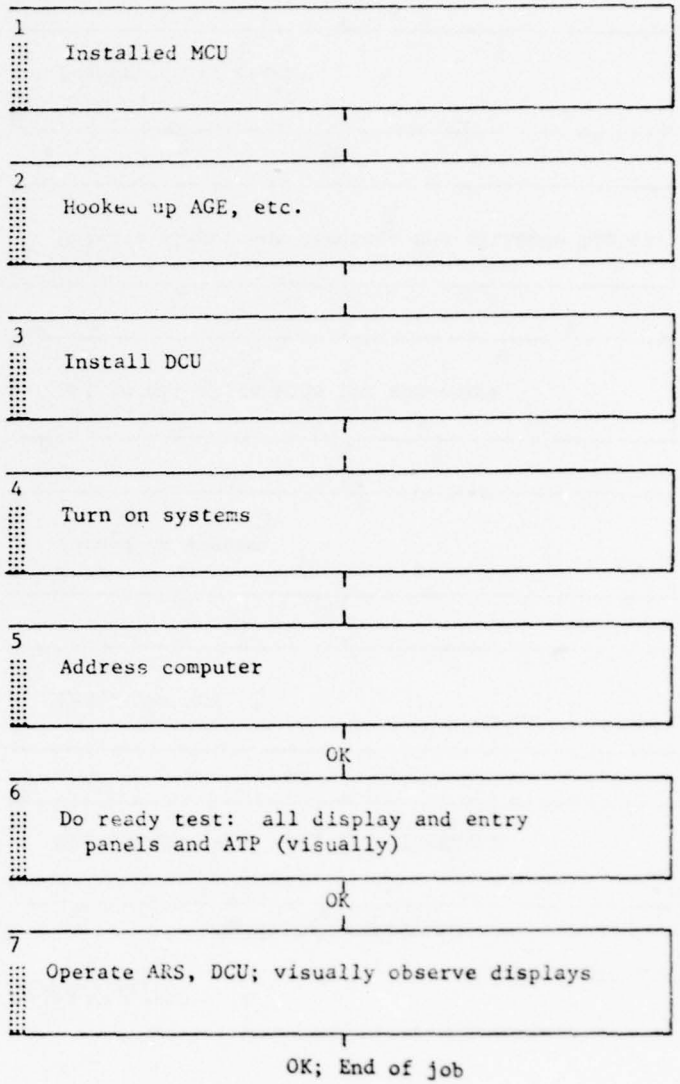
EXPERT COMMENT:

MM should have checked designator, freeze, and tilt.

AIRCRAFT FOLLOWUP:

The DCU had been removed on the previous shift and bench checked and repaired by the TS. The MCU had been removed on the previous shift. The test station found "incorrect voltages." No 73S discrepancy after next sortie.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 137 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	1010674	1010674	1010674		
TM	B	B	B		
WUC	73 PAO	73 PAO	73 PKO		
AT	R	X	R		
WD	F	F	F		
HM	242	242	242		
Start:	11 1400	11 1500	11 1530		
Stop:	11 1500	11 1530	11 1630		
Skill	7	7	7		

NARRATIVE OF MAINTENANCE ACTION:

ARS problems prompted this maintenance action. Roadrunner declared the antenna bad. In any case, MM found the MRU in bad condition and replaced it.

The tech orders were monitored closely during op checks and during troubleshooting via the computer. Tasks 6 and the R&R task, #7, were performed based on memory. Training was through OJT.

EXPERT COMMENT:

The first felt that the MM had accepted the RR opinion too confidently. A second reviewer felt that the MM should have checked MRU via computer addressing.

AIRCRAFT FOLLOWUP:

This JCN is missing from discrepancy listing. No 73P discrepancy write-up occurred following next sortie of a/c 8133.

Activity Sequence

1. Hooked up AGE (-60, -10)
2. R&R ARS antenna because Roadrunner found it defective.
3. Checked ARS via ATP self-test and display

Bad antenna light and no display

4. Addressed computer

Antenna not scanning

5. Visual check of antenna
6. Physical test of antenna torque

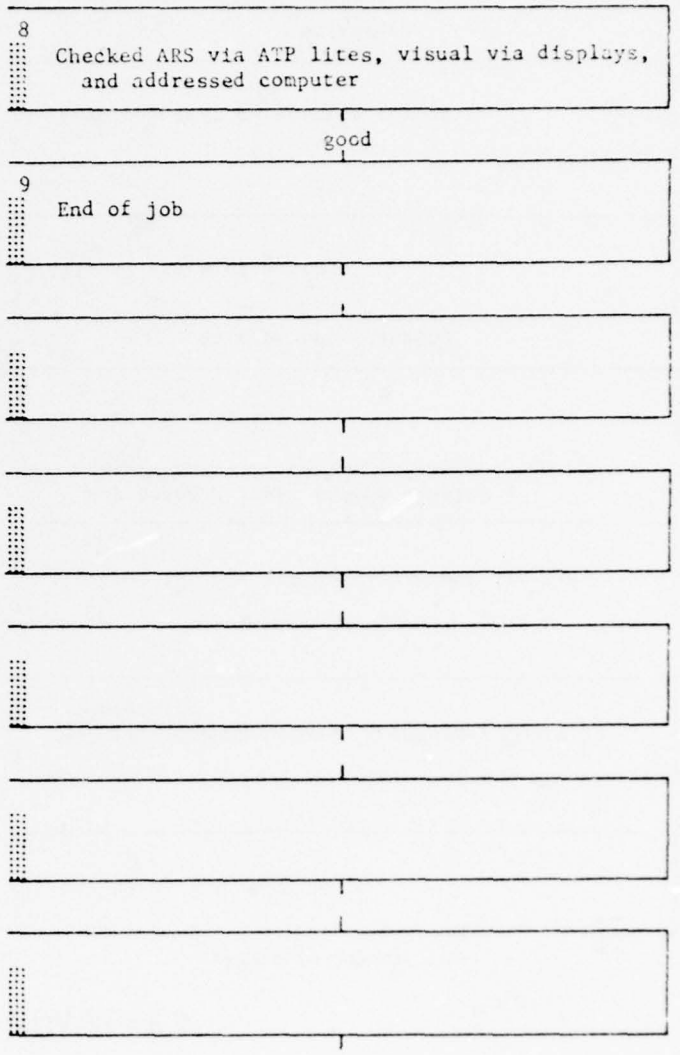
No torque

7. Believed MRU controlled torque; therefore R&Red MRU

FIELD OBSERVATION SUMMARY

Rand ID 137 Work Center A Shop System 73P

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 138 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0970763	0970763	0970763		
TM	B	B	B		
WUC	73SDO	73SOO	73SGO		
AT	Q	X	P		
WD	D	D	D		
HM	799	242	242		
Start:	09:1910	09:2010	09:2110		
Stop:	09:2010	09:2110	09:2210		
Skill	5	5	5		

NARRATIVE OF MAINTENANCE ACTION:

MM was required to replace the NDEP but, having done so, he found the system still defective. During troubleshooting he concluded that the MCU was probably bad and was introducing random degrades which appeared in the ATP status lamps. Therefore he R&R the MCU and addressed the computers to verify a good system.

No MCU was available to leave in this aircraft. The MM used the Preliminary Tech Order when addressing the computer in search of defective LRUs. Other tasks were performed from memory.

The tech school used the FB-111A for instructional purposes and it was not pertinent to the F-111D system.

The techniques of this task were learned through OJT nd experience in flight-line shops.

Activity Sequence

1. Hooked up AGE (-60, -10)
2. Install NDEP
3. Turn on systems
4. Check (visually) visual displays on NDDP

OK temporarily - then failed

5. Tried recycling: WDC and GNC off and on

Bad display panel - chicken tracks

6. Tried another recycle

No improvement

7. Addressed computer twice

WDC and GNC OK

FIELD OBSERVATION SUMMARY

Rand ID 138 **Work Center** A Shop **System** 73S

NARRATIVE OF MAINTENANCE ACTION: (continued)

EXPERT COMMENT:

First--JSA.

Second expert--MM was inefficient. He should have done more computer addressing, e.g., at step 9, time and effort would have been decreased. Some other tests did not serve to clarify the situation.

AIRCRAFT FOLLOWUP:

1. This installation appears to follow a removal which the TS designated as "no defect."

2. This action led to MCU removal. A TS action soon after involved bench check and repair.

No 73S write-up after the next sortie.

Activity Sequence

8 Entry mode FAIL lite came on ATP

9 Ran other tests by switch settings--observed ATP lites

10 Recycled computers

Same ENTRY MODE FAIL lite

11 Performed other ATP tests (fail lite)

MCU failure indicated by many different answers.

12 Turned off all but DCC; disconnect MCU

All displays OK

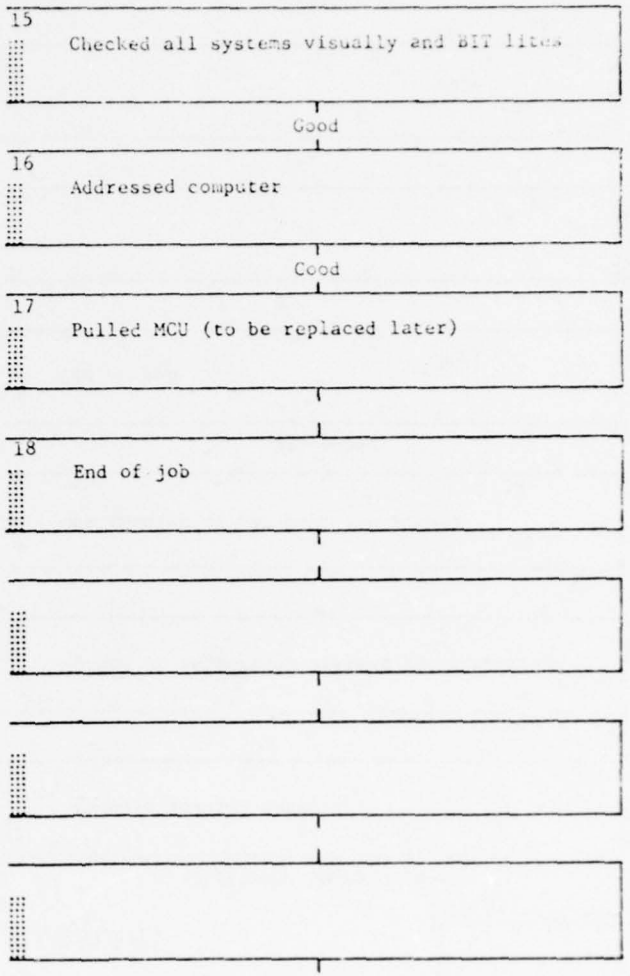
13 (Could address computer but could not do "fault recall.")

14 Removed MCU; installed MCU borrowed from shop

FIELD OBSERVATION SUMMARY

Rand ID 138 Work Center A Shop System 73S

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 200 Work Center A Shop System 73K

349 Data

	1	2	3	4	5
JCN	0841018				
TM	B				
WUC	73 K00				
AT	X				
WD	F				
HM	799				
Start:	01 1600				
Stop:	01 1700				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

C Shop had changed an interphone box and A Shop was required to ops check a TFR.

Standard ops check. All procedures were learned on the job. The use of the T.O. was from memory.

EXPERT COMMENT:

First reviewer: a partial audio check would have been sufficient. The second "could not argue" with this procedure if the MM had really followed the T.O. but that it could not be determined if the T.O. had been correctly followed.

AIRCRAFT FOLLOWUP:

No data this JCN; no discrepancy report following next sortie (4/2).

Activity Sequence

1 Standard initial setup

2 Turned on supporting systems and computers

3 Ops checked as per T.O. (40 steps)

All good

4 End of job

FIELD OBSERVATION SUMMARY

Rand ID 201 Work Center C Shop System 65A

349 Data

	1	2	3	4	5
JCN	0910702				
TM	B				
WUC	65 AAO				
AT	L				
WD	D				
HM	127				
Start:	01 1600				
Stop:	01 1700				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Air/Ground IFF was inoperative on ground station. Technician felt that since problem was on a specific station, the problem was most likely pilot error or ground station failure. Therefore, he did not take test equipment but did check. Would have CND but did find system was misaligned. Procedures were learned on the job and are not covered in T.O.

EXPERT COMMENT:

1st--JSA.

2nd--MM should have used test set after step 2.

AIRCRAFT FOLLOWUP:

Discrepancy on next flight; "AC IFF (65AAO) cannot be received by control."

Activity Sequence

1. Standard start, hooked up -60.
2. UHF power on--contact local ground station
   - Good
3. Put A/G IFF on standby and tuned in squawk mode
4. Called departure
   - Good
5. Check alignment and adjust--turn switches, observe dials.
   - Good
6. End of job

FIELD OBSERVATION SUMMARY

Rand ID 202 Work Center C Shop System 63A

349 Data

	1	2	3	4	5
JCN	0910703				
TM	B				
WUC	63 AAD				
AT	R				
WD	D				
HM	290				
Start:	01:1700				
Stop:	01:1805				
Skill	5,3				

NARRATIVE OF MAINTENANCE ACTION:

Continuation of job 201. Previous job used UHF. Before UHF was turned off, there was a power failure. A visual check of circuit breakers and fuses. There were two possible alternatives. The technician took a "shot in the dark," which appeared to correct the problem. The use of the test set was carried out by directly following T.O.

EXPERTS COMMENTS:

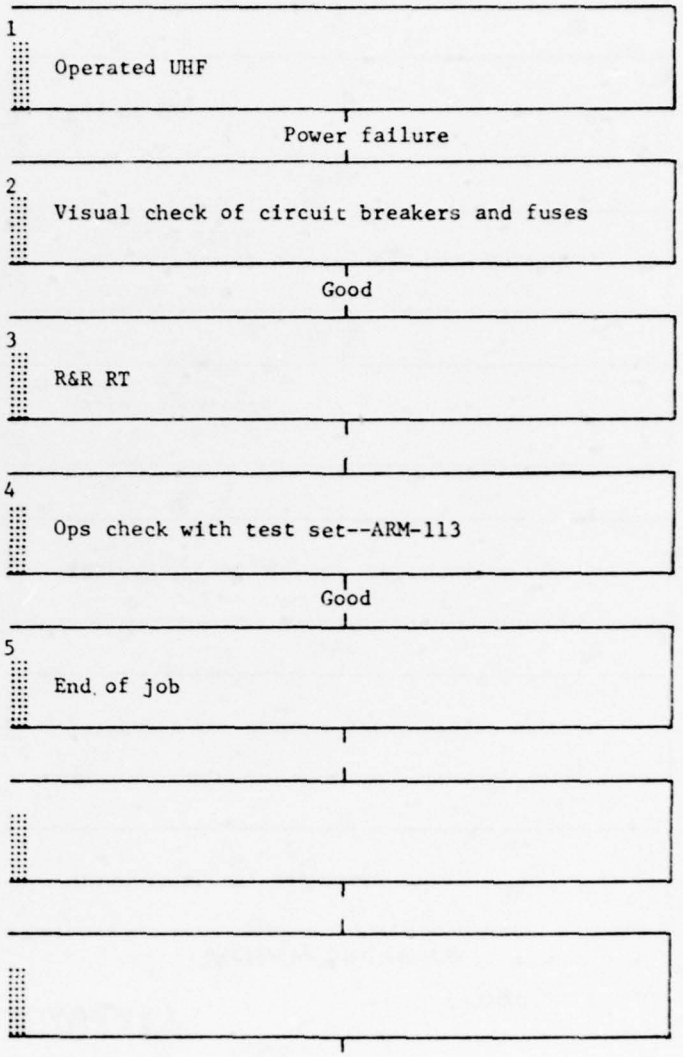
First: JSA. Second: MM probably did a self-test which he forgot to mention.

In step 3, the RT or the C/B is probably defective, but most likely the RT so it is R&Red first.

AIRCRAFT FOLLOWUP:

TS repaired the unit. No discrepancy report next flight.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 204 Work Center _____ System 73P

349 Data

	1	2	3	4	5
JCN					
TM					
WUC	73P__				
AT	(H)				
WD					
HM					
Start:					
Stop:					
Skill					

NARRATIVE OF MAINTENANCE ACTION:

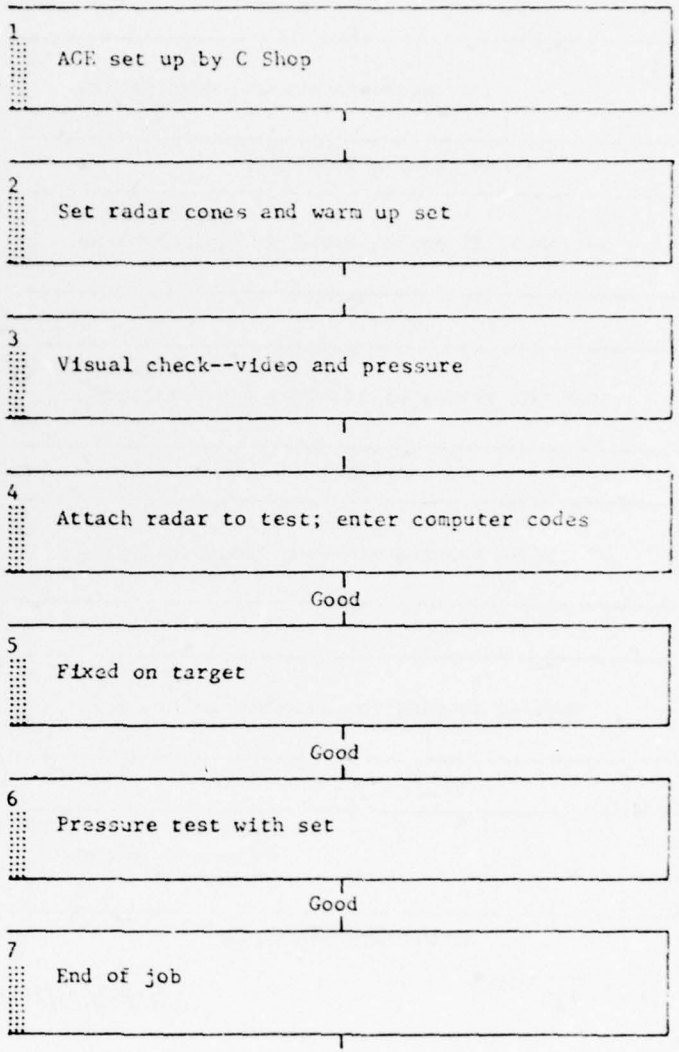
Radar intermittent failure. All procedures were learned on the job. The technician's decision to "lock on target" and pressure test was from his experience. All systems OK and job CND.

EXPERT COMMENT:

The job description is not clear.

(Lack of JCN precludes aircraft followup.)

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 205 Work Center A Shop System 73H & P

349 Data

	1	2	3	4	5
JCN	0910747	0910749			
TM	B	B			
WUC	73HP0	73P00			
AT	R	H			
WD	D	D			
HM	242	812			
Start:	011700	011800			
Stop:	011800	011815			
Skill	5	5			

NARRATIVE OF MAINTENANCE ACTION:

The original problem was that the WDC would not come up. Actions consisted of analysis of BITE indication, computer read-out verification of converter set failure, and verification by substitution. Tech. Orders were generally followed from memory. All experience was gained from MISD and OJT.

EXPERT COMMENT:

Two JSA evaluations.

AIRCRAFT FOLLOWUP:

T.S. 1) 607, A.Next sortie, repeat 73H
2) No TS action. Next sortie, repeat 73P

FIRST JCN: TS action was A, 607 with a repeat on the 73H system on the next sortie. No TS action on the second job. There was a repeat on 73P next flight.

Activity Sequence

1. Normal job setup
2. Power on to computer and support systems
3. BITE indicator; Comp-NAV-Weapons on ATP

failed

4. Monitoring the computer indicated WDC shut down.
5. Addressed GNC computer to see if converter set failed

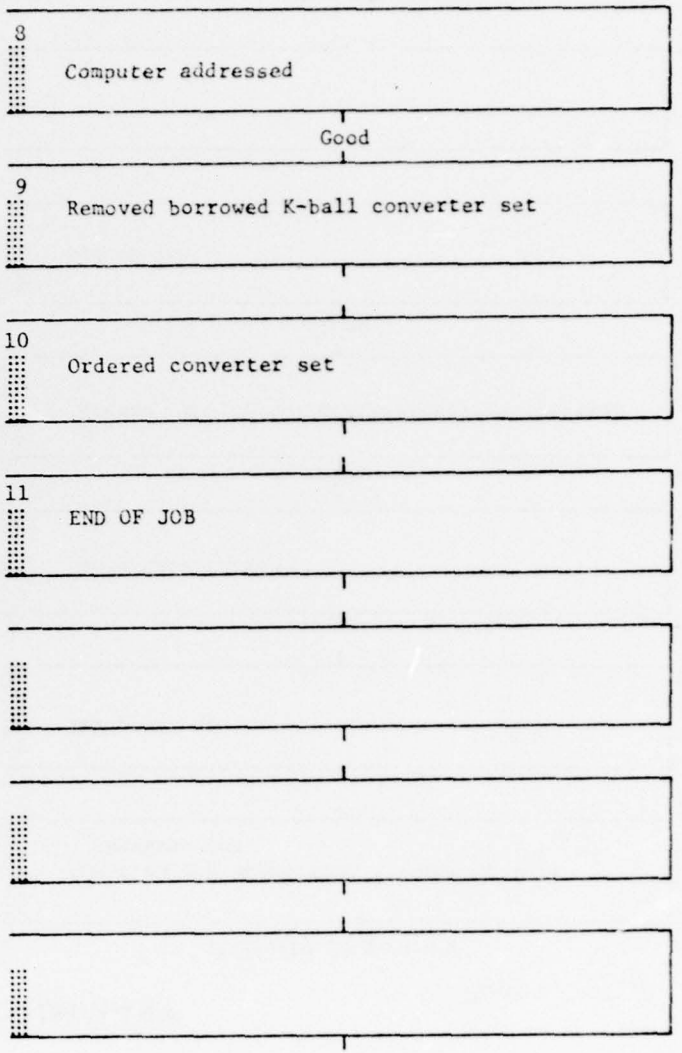
Indicated c/s failed

6. Called shop for new converter set - K Ball
7. Verified with new converter set

FIELD OBSERVATION SUMMARY

Rand ID 205 Work Center A Shop System 73H & P

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 206 Work Center A Shop System 73P

349 Data

	1	2	3	4	5
JCN	0910751				
TM	B				
WUC	73 HGO				
AT	L				
WD	D				
HM	127				
Start:	1630				
Stop:	1645				
Skill					

NARRATIVE OF MAINTENANCE ACTION:

The original writeup was that the ARS fixed range markers were out of calibration.

Procedures to calibrate IDS were learned in the MISD.

T.O.s were followed from memory.

EXPERT COMMENT:

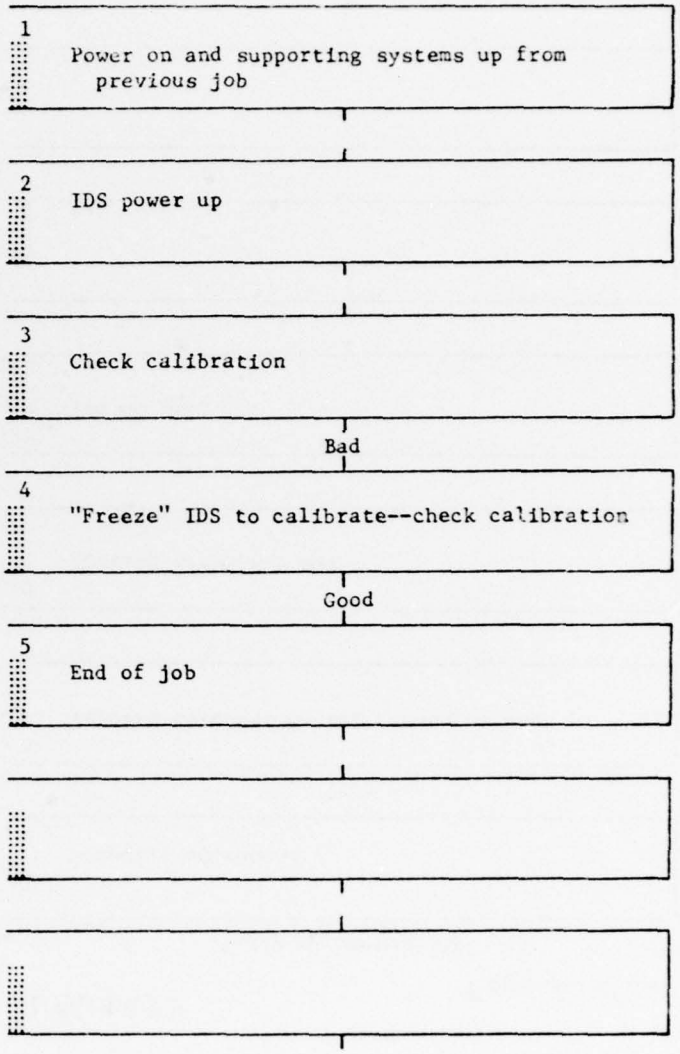
Freeze procedures are not for fixed range markers problem (good for cursor calibration only).

Range marker problem would indicate EPU malfunction.

AIRCRAFT FOLLOWUP:

73H system had discrepancy on next flight (but not in regard to ARS range markers)--WDC, GNC, and NDEP down.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 207 Work Center A Shop System 73H

349 Data

	1	2	3	4	5
JCN	0910748				
TM	B				
WUC	73HCO				
AT	L				
WD	D				
HM	127				
Start:	1645				
Stop:	1700				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The original writeup was an INS Dump.

The decision to do the "Gyro test" was a "quick check-short cut" learned on the job but not in the Tech. orders. In all other steps T.O.s followed from memory. The MM learned to perform job through OJT.

The reseating action was to avoid a CND (799) and a supervisor's inspection.

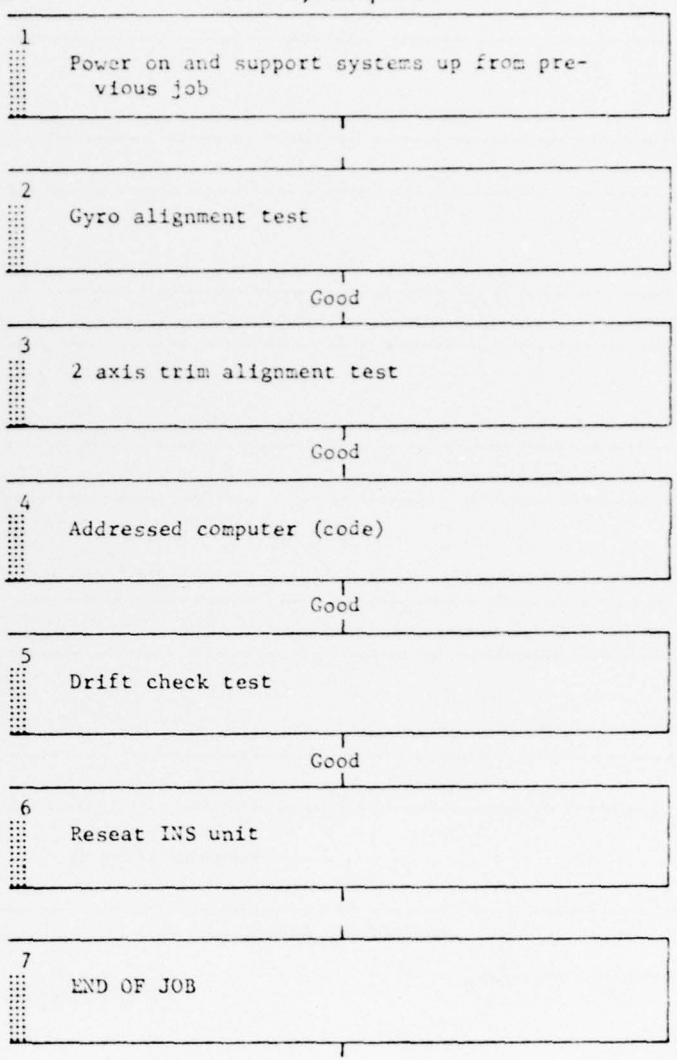
EXPERT COMMENT:

The first commented that the two-axis trim alignment was not needed; the second that reseat was not necessary since a 2-axis trim had been performed.

AIRCRAFT FOLLOWUP:

There was a write-up next flight on 73H system — 73HPO was a repeat write-up.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 208 Work Center A Shop System 730

349 Data

	1	2	3	4	5
JCN	0570685				
TM	B				
WUC	73 QAO				
AT	Q				
WD	F				
HM	799				
Start:	01 1705				
Stop:	01 1910				
Skill	3,5				

NARRATIVE OF MAINTENANCE ACTION:

The job was to install a doppler antenna.

The job was learned through OJT and followed the T.O.s from memory.

(No EXPERT COMMENT)

AIRCRAFT FOLLOWUP:

JCN listed but no 349 action.

No trouble this system on next flight (3/21).

Activity Sequence

1 Install antenna

2 End of job

FIELD OBSERVATION SUMMARY

Rand ID 209 Work Center A Shop System 73S

349 Data

	1	2	3	4	5
JCN	0860506				
TM	B				
WUC	73 SCO				
AT	Q				
WD	F				
HM	799				
Start:	01 1830				
Stop:	01 2000				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

The job was to install a new panel light.

The DCC was checked because panel had been removed.

Tasks learned from OJT and followed the T.O.s from memory.

EXPERT COMMENT:

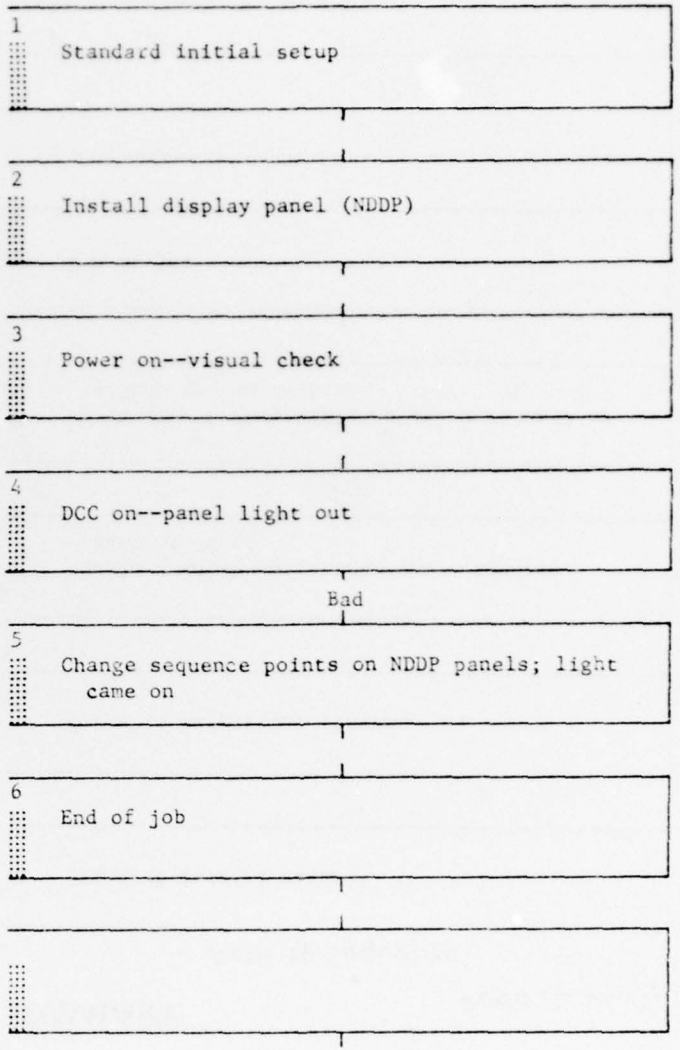
First--Further ops checks necessary. Should have used T.O.s as this ops check is too complicated to recall from memory.

Second expert--JSA.

AIRCRAFT FOLLOWUP:

No record this JCN in BLIS data. Next flight on 4/2. No 73S write-up.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 210 Work Center C Shop System 71B

349 Data

	1	2	3	4	5
JCN	0910763				
TM	B				
WUC	71 B00				
AT	X				
WD	D				
HM	812				
Start:	01 1830				
Stop:	01 1915				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

The original writeup was that the TACAN course flag appeared. The TACAN checked out OK. The MM checked with A Shop--also working A/C on another squawk--and determined that A Shop system failure was responsible.*

The standard ops check was learned in FTD; all else OJT. T.O.s were followed from memory.

EXPERT COMMENT:

1st--JSA.

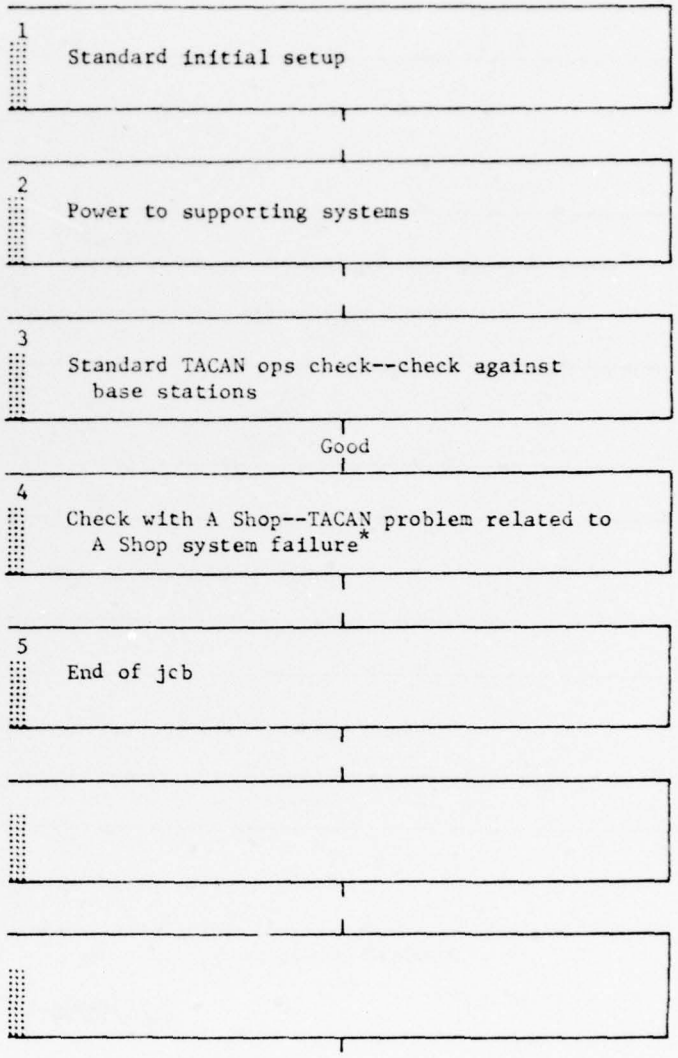
2nd--Need more info regarding A Shop action to evaluate this C Shop decision.

AIRCRAFT FOLLOWUP:

No TACAN problems developed on future April sorties.

*Record shows only prior A Shop job to be check resulting in "no defect."

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 211 Work Center C Shop System 63A

349 Data

	1	2	3	4	5
JCN	09100762				
TM	B				
WUC	63 AAO				
AT	R				
WD	D				
HM	693				
Start:	01:1730				
Stop:	01:1830				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

Recurring writeup on poor quality UHF.

Because of past history, it was decided to R&R UHF.

MM indicated that he was first exposed to this type of problem in Tech. School and FTD

EXPERTS COMMENTS:

First: JSA. Second: MM should have used test set at step 4, especially since this was a recurring writeup.

AIRCRAFT FOLLOWUP:

The UHF unit was found to need repair by the TS. No trouble next flight.

Activity Sequence

1. Power on from previous job
2. Turn on unit and verified poor quality
3. R&R UHF
4. Ops check--called shop, verified good quality
5. End of job

FIELD OBSERVATION SUMMARY

Rand ID 212 Work Center C Shop System 65A

349 Data

	1	2	3	4	5
JCN	0910759				
TM	B				
WUC	65 ACA				
AT	L				
WD	D				
HM	290				
Start:	01 1915				
Stop:	01 2000				
Skill	5,5				

NARRATIVE OF MAINTENANCE ACTION:

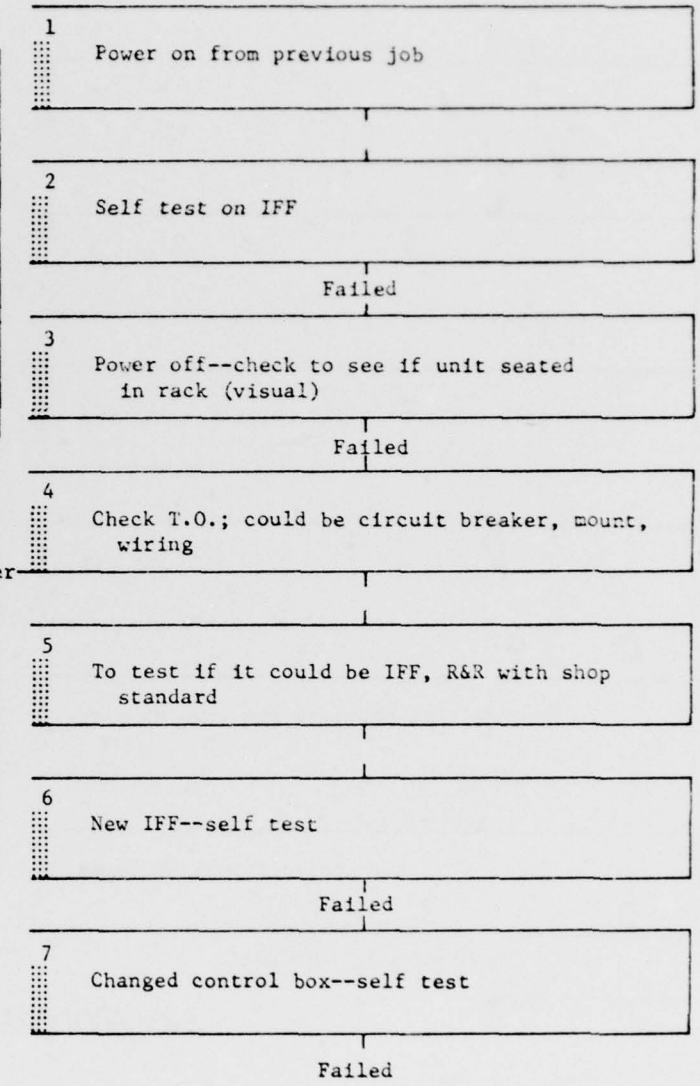
The original writeup was that the air to ground IFF failed in flight. This aircraft had a history of IFF mount problems. From experience OJT, MM determined to visually check seat. Reference to T.O. would require removing the mount, but because this is a large job, they decided to verify by: 1) replacing with new shop standard IFF and 2) replacing with new control box. Before they could remove mount, su[illegible]isor made them check power to mount and reseat. This t[illegible]lt worked.

Most of the procedures were lea[illegible]ed in FTD. The reseat troubleshooting was from OJT. There was direct referral to the T.O. troubleshooting section which advised them to replace the mount.

EXPERT COMMENT:

Both reviewers agreed that the sequence of steps was reasonably correct and that the job description was complete. Neither felt that the right conclusions had been drawn at the decision points.

Activity Sequence



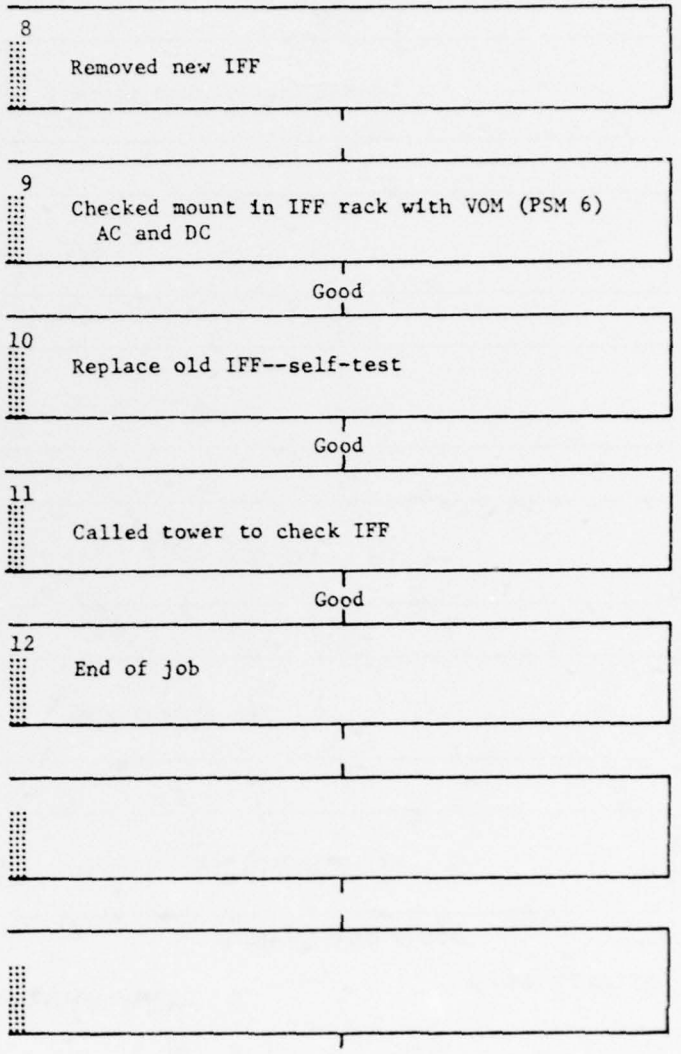
FIELD OBSERVATION SUMMARY

Rand ID 212 Work Center C Shop System 65A

AIRCRAFT FOLLOWUP:

This was a repeat discrepancy. A/G discrepancy reappeared the flight after next.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 213 Work Center C Shop System 63A

349 Data

	1	2	3	4	5
JCN	0900770	0900770			
TM	B	B			
WUC	63 A00	63 AA0			
AT	Y	R			
WD	D	D			
HM	693	693			
Start:	01 1600	01 1700			
Stop:	01 1700	01 1800			
Skill	5,5	5,5			

NARRATIVE OF MAINTENANCE ACTION:

The original writeup was no reception on left seat UHF. The "sound check of ADF" is not in T.O.s and was learned through OJT. The UHF self test was learned from FTD.

EXPERT COMMENT:

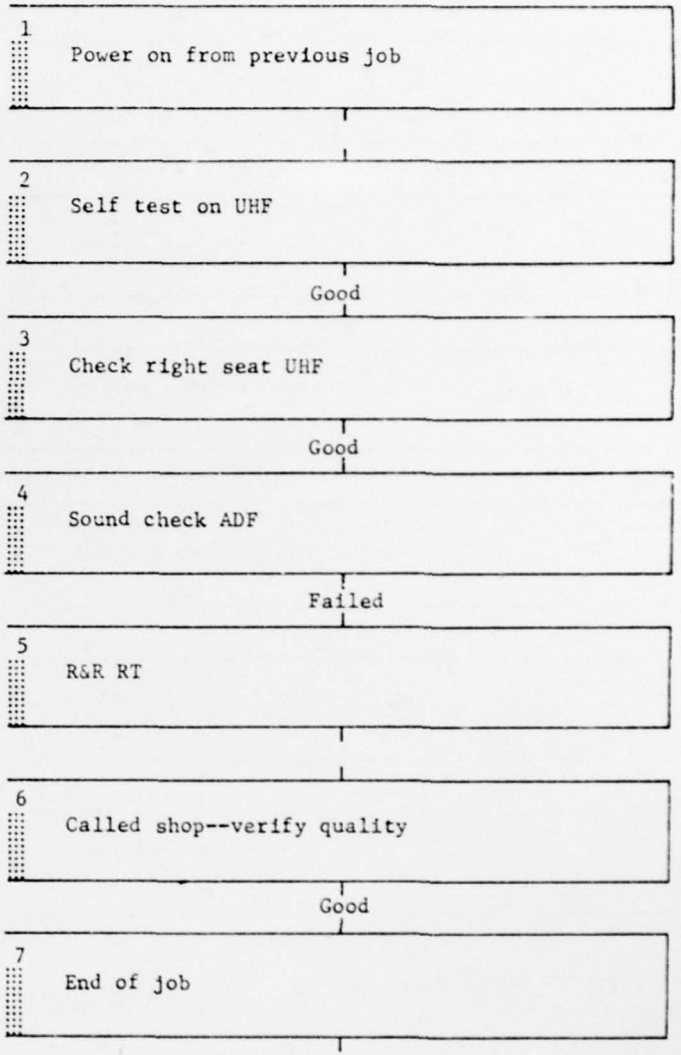
1st--JSA.

2nd--Poor sequence of MM actions; should also check interphone control box & PE lead. Information not sufficient to determine why RT was changed first rather than ADF amplifier.

AIRCRAFT FOLLOWUP:

TS later repaired a 63AA0 unit. No problems this system (63A) the rest of April.

Activity Sequence



FIELD OBSERVATION SUMMARY

Rand ID 214 Work Center _____ System _____

349 Data

	1	2	3	4	5
JCN	0920661				
TM	B				
WUC	73SG0				
AT	Q				
WD	F				
HM	799				
Start:	01:1600				
Stop:	01:1700				
Skill	5				

NARRATIVE OF MAINTENANCE ACTION:

This job consisted of installing and ops checking an MCU.

The task was learned in the MISD and on the job. There was direct use of the T.O.s only during the MCU self-test step.

EXPERT COMMENT:

JSA.

AIRCRAFT FOLLOWUP:

No record this JCN. No 73S write-up following sortie on 4/3 (first sortie of the month).

Activity Sequence